AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 10, No. 21 WEEKLY. | NEW YORK, MAY 21, 1887. | $2.50 per Annum. SINGLE COPIES, 5 CENTS.

COPYRIGHT 1887, BY AMERICAN MACHINIST PUBLISHING COMPANY.

For Sale Everywhere by Newsdealers. ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Park Injector.

The instrument which we illustrate herewith is adapted for feeding all kinds of steam boilers, and is designed to perform its functions under varying steam pressure without any adjustment. It also accomplishes its ends without multiplying parts.

This injector is a double jet apparatus, the first jet lifting and delivering the water into the second, when its velocity is sufficiently increased to overcome the pressure in the boiler.

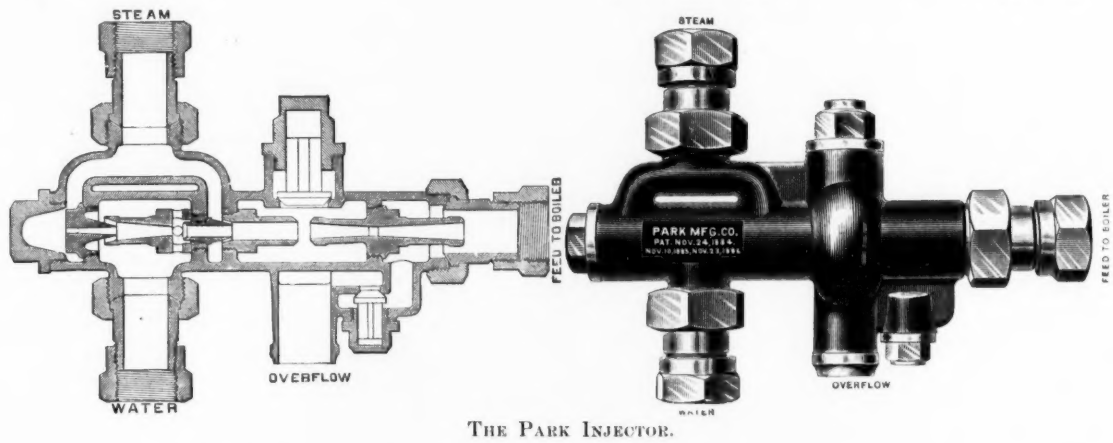
Its action is positive, and it maintains its duty under the varying steam pressures, therefore no adjustment is required.

The combined area of the two steam nozzles is less than the area of steam nozzles in any single jet injector of the same capacity, consequently its duty should necessarily be high. This combination of the two jets and its self-governing qualities, without movable parts in its internal construction, makes the injector less sensitive to jar and other disturbances, and less liable to get out of order.

The arrangement of the jets and openings is such that it only requires the opening and closing of the valve in the steam pipe to start and stop it, thereby making it simple and requiring the minimum of skill to operate.

The nipples for connecting are supplied with a brass coupling of hexagonal sides, and can be connected to the pipes with a common wrench.

The manufacturers are the Park Mfg. Co., 34 Beach street, Boston, Mass.



THE PARK INJECTOR.

An Inventive Farmer.

According to the *Los Angeles Times*, a farmer in that vicinity combines the faculty of adapting the means to the end desired in a degree that makes the successful inventor and engineer. He had a tract of land useless without irrigation, which he was unable to provide for in the usual way; and he also had a family of twelve children. In his case the rising generation of family offshoots were the means, and irrigation the desired end. He had money enough to dig a well, buy a low-priced pump and a gigantic family swing, of the picnic order. He connected the pump to the swing, gave the youngsters full liberty to amuse themselves with the latter, the result being a stream of water that makes the arid soil fairly smile. Nothing less than enough measles or hooping cough to go "all around" will stop the supply of water.

We suggest to writers on the locomotive engine that it is time they stop referring to the locomotive as an engine operated by "exceptionally high steam pressure." Marine engines, compound and triple expansion, are using steam of higher pressure than the locomotive, and to excellent advantage.

The Pennsylvania Railroad Co. will immediately commence to build forty new freight locomotives.

New Upright Drill.

The drill which we illustrate herewith is made by the Bickford Drill Company, Cincinnati, Ohio.

This drill is made from new patterns, the design being carefully considered to the end of producing a strong machine for the heaviest work required, and at the same time a machine quickly and easily operated.

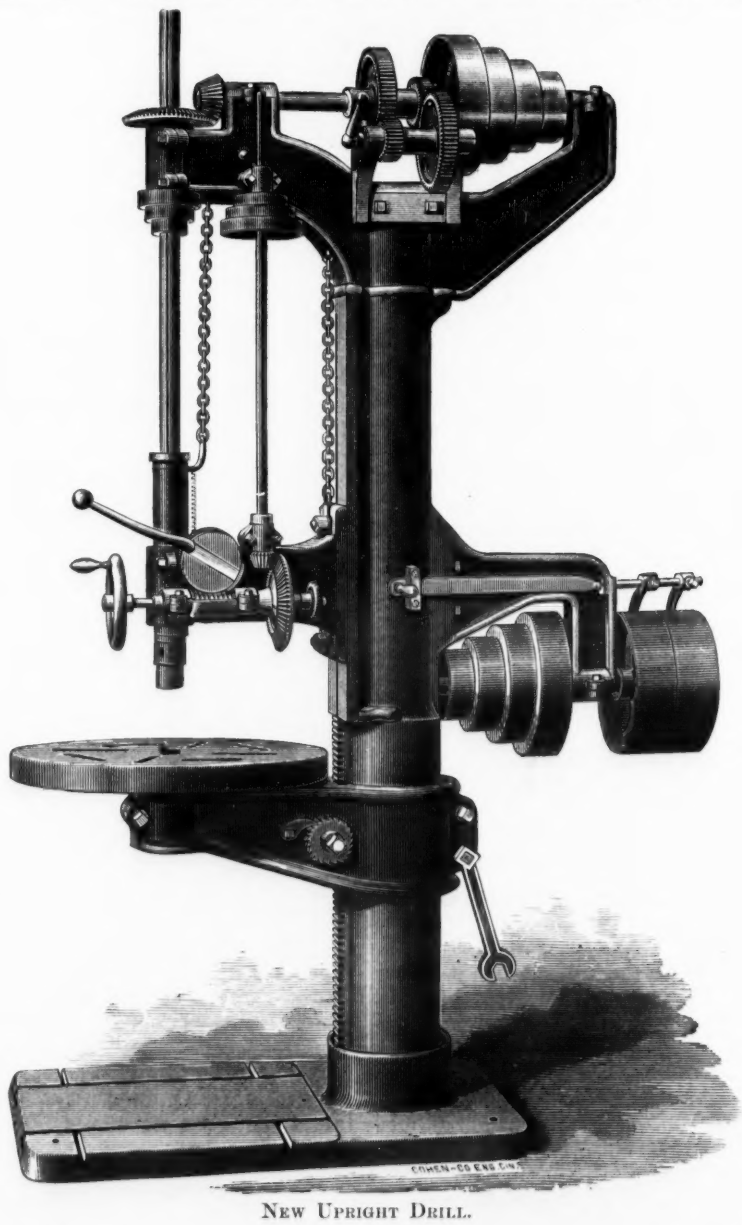
All spindles and shafts are made of steel.

The sliding head and spindle are counterbalanced, so that the spindle cannot drop and cause trouble when the drill has worked its way through the metal.

The spindle has quick return, the handle for operating being placed on the same side as the hand-wheel for operating the worm feed; placing all operating mechanism on one side of the machine avoids the necessity of the operator changing hands, and hence expedites the operations.

The device for engaging the lever with the worm ring is simple and positive, only requiring a slight pressure outwardly to engage it, or a slight pull to disengage it.

The cam pulleys are of ample dimensions to give strong driving power, and the back gearing is strong and easily thrown into service.



NEW UPRIGHT DRILL.

Dr. A. W. Wilkinson, chemist of the New York Mutual Gas Light Company, is the inventor of a patented process for restoring the lime used in gas works to purify the gas, so that it can be used over and over again repeatedly, instead of being carted away and new supplies carted in. This process is in use by the Mutual Gas Light Company, and it is claimed that a saving of $50,000 a year is the result. It is believed the process can be used advantageously for other purposes, as in soap making.

There is always an inclination to call things by a wrong name. We hear of cable propulsion for street roads, and it always seems to be put in juxtaposition to steam propulsion, as if cable propulsion were not steam propulsion, with a big percentage of useful effect lost. So with electric propulsion; there is a large loss of useful effect. But in either case it may be advisable to submit to this loss, but it is loss, all the same. There is not a cable road, or an electric road, that is running with the same economy, so far as coal consumption and a definite amount of work is concerned, as a road could be run with a locomotive, pure and simple. And there is not the remotest probability that for economy of pulling tons weight over the road for a given coal consumption, that the locomotive will be beaten.

Newspaper Syndicates.

The "syndicate" is a well-known kind of institution among daily newspapers. Letters of news, gossip and general comment are written at the headquarters of several active newspaper men (or sometimes only one man), usually in New York city, and sent at the same time to a number of newspapers in different parts of the country, taking care to send to no two that are near together. An original letter, worth $75 or $100, can be used without interference by twenty or thirty newspapers, and the cost reduced accordingly. This works very well for the dailies; but syndicates are now offering letters to technical newspapers. Some have been offered to us. We do not care to use any of them, believing that we can fill our columns with better material than can be furnished on that plan.

The Worcester (Mass.) Free Institute has received from Stephen Salisbury a gift of $100,000, to be applied most usefully in building a mechanical, physical and chemical laboratory, the want of which has long been felt. There is plenty of room for men of means in every large city in the country to emulate the example of Mr. Salisbury, with most excellent results.

Exhaust Tumbling Barrels.

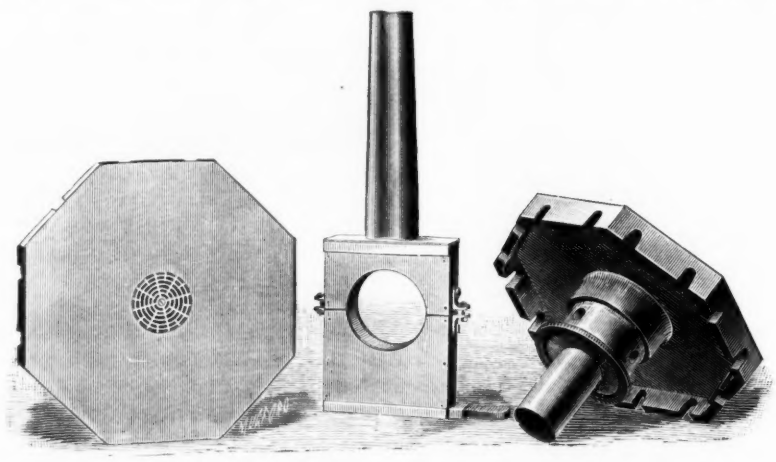
Tumbling barrels occupy a place of importance in some of the principal branches of modern industry. So cheaply is a smooth, bright surface obtained by their use that the form of many finished articles is determined with reference to it. The many purposes for which they are used—ranging from the pulverizing of coke to the burnishing of brass buttons, and from the cleaning of heavy castings to the brightening of tiny tacks—have led to the bestowal of much thought upon them. Slowly, improvements have been developed, because manufacturers, as a rule, have made their own, each having his own preferences as to form and size, ways of mounting, driving, and so forth, which made it difficult for any one to make a specialty of their manufacture and introduce a style which would please every one. Such preferences can still be retained, as the exhaust can be applied to almost any plain barrel now in use; although it is better to construct the barrel expressly for it, and the preferences can then be wrought in also. For at least thirty years nail and tack manufacturers have employed air currents to carry off the dust and hasten the brightening of their goods when being tumbled in barrels; yet it is not generally known what a saving of time it makes, and how much better the work is done.

A properly constructed barrel, connected with an exhaust fan, keeps all the debris within it till the fan removes it and deposits it in a proper place outside the building.

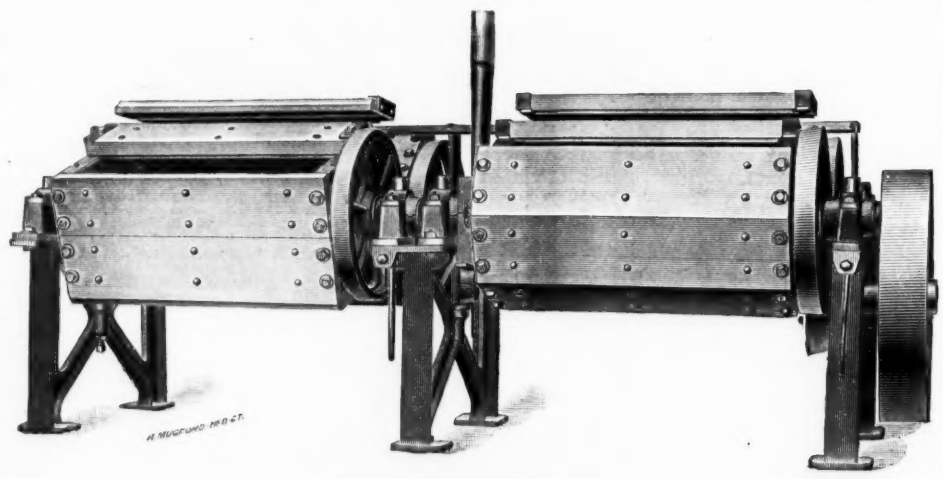
The damage which is done in some establishments by the dust from the barrel room permeating other rooms and polluting the finished goods is so completely remedied by the use of exhaust barrels, that the wonder is why the old nuisance was so long tolerated.

Whilst either blast or exhaust may be used, the exhaust allows a simpler construction of the barrel, and it gives the best results from the power expended to drive the fan. A small pipe with a quick draft through it, when connected with a well-made barrel, which only the smallest possible streams of air can get into, removes the dust as fast as the tumbling can separate it from the articles, and as the film of dirt which envelops them is removed, the articles rub closer together and are cleaned and brightened rapidly; the small, sharp, inrushing streams of air aiding very considerably in the work.

The tumbling barrels illustrated herewith are made by Henderson Brothers, Waterbury, Conn.



Details of Tumbling Barrel.



Exhaust Tumbling Barrel.

Washington Meeting of the American Society of Mechanical Engineers.

The secretary of the American Society of Mechanical Engineers has issued a circular relating to the Washington meeting. The meeting will continue from May 31 to June 3. The circular says:

The professional sessions of the meeting will be held in Willard's Hall, adjoining Willard's Hotel, Pennsylvania avenue, corner Fourteenth street; and the headquarters and secretary's office will be in Parlor 10 in that hotel, on the first floor. The hall is entered through the hotel. Pursuant to special arrangement, members at this house will secure rooms at $3.00 per day, and it is hoped that as many as possible will stay at this place. Members will further find the special early lunch which will be provided for attendants at the convention to be a great convenience.

In view of the number and variety of interesting points to be visited, it has been decided to leave one-half of each day without assignment, so as to allow parties to select for themselves the public buildings which they care most to see. Inasmuch, also, as many of the buildings are closed to visitors after 2 P. M., the mornings are left free, after the first day, to be utilized for such visits.

FIRST DAY, TUESDAY, MAY 31.

Opening session, Willard's Hall, 10 A. M.
Business session, reports of committees, etc. Professional papers and discussions will follow.

In the afternoon of this day it is suggested that the visit to the Capitol building and the Corcoran Gallery be made. The latter is on the corner of Seventeenth street and Pennsylvania avenue.

In the evening at 8 P. M., in Willard's Hall, session for professional papers and discussions.

SECOND DAY, WEDNESDAY, JUNE 1.

The morning will be given to visits of points of interest in the city. The Bureau of Engraving and Printing, and the National Museum and Smithsonian Institute have been suggested as eligible places.

After an early lunch at the hotel the professional session will convene at 2 P. M., in Willard's Hall.

In the evening, by the courtesy of the Hon. Josiah Dent, a reception is tendered to the society, at his residence, 3,101 U street, West Washington, between the hours of 7 and 10 P. M. The house belongs to the colonial period of the city, and is notable as the one in which Lafayette was entertained by John C. Calhoun. This reception will also furnish an opportunity to meet some of the representative residents of the city in addition to the social re-union of the members. It is specially urged that no one should stay away because not provided with evening dress.

THIRD DAY, THURSDAY, JUNE 2.

A trip by boat down the Potomac to the home of Washington, at Mt. Vernon, has been arranged for this day. A boat will leave the Seventh street wharf at 10 A. M., returning in the afternoon. Tickets for the round trip, including luncheon at Marshall Hall, opposite Mt. Vernon, will be $1.50, and will be procurable on the boat.

In the evening, the fourth professional session will be held (at which the Topical Discussions will be a special feature) at Willard's Hall, beginning at 8 P. M.

FOURTH DAY, FRIDAY, JUNE 3.

The morning is again left without assignment, to admit of visits to the Patent Office, Navy Yard or Naval Observatory, as may be selected. Carriages will also be provided at reduced rates, by special arrangement, to take parties which may be made up to visit Cabin John Bridge, which is one of the largest stone arches in the world, or, where preferred, to visit the Soldiers' Home; both are just outside of the city. These conveyances will leave Willard's Hotel at 10 A. M.

In the afternoon, the fifth and concluding session will be held in Willard's Hall, at 2 P. M., adjourning in time to allow members to catch evening trains out of the city.

The following papers are to be presented and discussed at this meeting.

Samuel Webber: "Tests of the Comparative Value of Different Kinds of Belting."

L. H. Rutherford: "Should a Piston Packing Ring be of the Same Thickness at Every Point."

John T. Hawkins: "The Education of Intuition in Machine Designing."

R. H. Thurston: "Systematic Testing of Turbines in the United States."

Chas. E. Emery: "Notes for Discussion on the Limit of Steam Pressure in Marine Engines."

Charles E. Emery: "Notes for Discussion on Cylinder Condensation."

Albert Stearns: "A Method of Evaporation by Means of Exhausted Steam."

Henry R. Towne: "Methods of Determining Cost and Distribution of Power and Heat."

Wm. Kent: "A Problem in Profit Sharing."

Chas. E. Emery: "Comparative Value of Steam and Hot Water for Transmitting Heat and Power."

Thos. S. Crane: "Direct Acting Steam Veneering Cutter."

H. A. Ramsay: "What are the Needs of our Navy."

R. H. Thurston: "Notes on Helical Seams in Boiler Making."

Jos. Morgan, Jr.: "National Defense and the Mechanical Problems which it Involves."

Geo. H. Babcock: "A New Method of Making Tubes from Solid Bars."

Following is the list of "Topical Discussions" to date; these will undoubtedly be added to:

39. What have you found the best methods for removing gas and smoke from blacksmith shops. (*Halsey.*)

40. What is the best cross section for the frame of a steam engine. (*Halsey.*)

41. What data can you give from your experience as to the working pressure of gear teeth. (*Halsey.*)

42. Is there a form of safety valve on the weight and lever principle suitable for boilers on small vessels in rough water. (*Cowles.*)

43. Is 6,000 pounds per square inch, as provided in the U. S. Inspection Laws for steam vessels, a necessary limitation for stays in marine boilers. (*Cowles.*)

44. What system of regulating the wages of labor in our manufacturing establishments will tend to make that labor most efficient, and produce the largest returns both to employer and employe. Give especially data from actual experience with effects of piece-work, premiums, participation in profits, gradation of wages, with terms of service, etc., etc. (*Kent.*)

45. What is the best method and form of tool for drilling small deep holes in steel; say a hole ½ inch in diameter drilled 4 feet into end of a steel shaft. (*Towne.*)

46. Have you made any use of calculating machines or tables, either in professional or commercial work; if so, with what results. (*Towne.*)

47. What limit of stress should be adjusted for chains as used on cranes. (*Towne.*)

48. What is the average efficiency of a man when turning a crank: Have you any data based on actual experience. (*Towne.*)

49. What is the average loss of efficiency from friction in ordinary hoisting machines operated by hand. (*Towne.*)

Another Manufacturers' Union.

And now it is the manufacturing silversmiths, who have recognized the need of forming a union for the purpose of dealing with labor difficulties. As yet, they appear only to have reached the combative or boycotting stage, and the result is open war with the labor organizations to which most of their workmen belong.

As matters now stand, the fight which the latter are making against the employment of apprentices in the shop where the trouble started, is about equally indefensible with the fight which the manufacturers' union is making against the right of their employes, as men and American citizens, to belong to such labor organizations as they choose.

It is to be hoped that both sides to this interesting dispute will soon see the advantage of meeting and settling their differences as naturally and reasonably as sensible men are in the habit of doing in other departments of business.

A Feature in the Progress of Shoe Machinery.

The development of improvements in shoe machinery runs in grooves. At any particular time the effort seems pretty much all in one direction. Last year there was an epidemic of edge setters and heel burnishers. Two and three years ago metallic fastenings and metal button fasteners had the call. Now, seam rubbers, shank burnishers, and, above all, lasting machines, claim the attention of inventors. In Haverhill, a new seam-rubbing machine is announced; in Lynn, has recently been devised a machine for corrugating a seam which does away with rubbing. In Boston, a practical shoe manufacturer has discovered a seam stay which can be applied without the use of any rubbing or corrugating machinery. Three or four machinists in as many quarters of the country each have a shank burnisher "ready for the market." Among all the new machinery, however, lasting machines now claim the most attention.

A good many years ago many thousand dollars were spent in an attempt to solve the problem of lasting by machinery. Out of all the effort and money thus expended came a machine that has been successfully employed on coarse, heavy work. Here the matter rested, and might have continued to rest had, not labor agitation offered a motive to manufacturers to try anything that promised them relief. There having come up an urgent demand for a lasting machine, extra effort has been made to produce one. At least five new machines are ready, or about ready, to appear on the market.

Four of these are tack machines, and have not yet been thoroughly tested in the factory. The remaining one is a complete departure from old-time usages. It is, in fact, a crimping or forming machine, crimps or forms the upper over the edges which of the last, holding it in position while the operator hammers it down and draws it close over bottom of last with strings, which he ties.

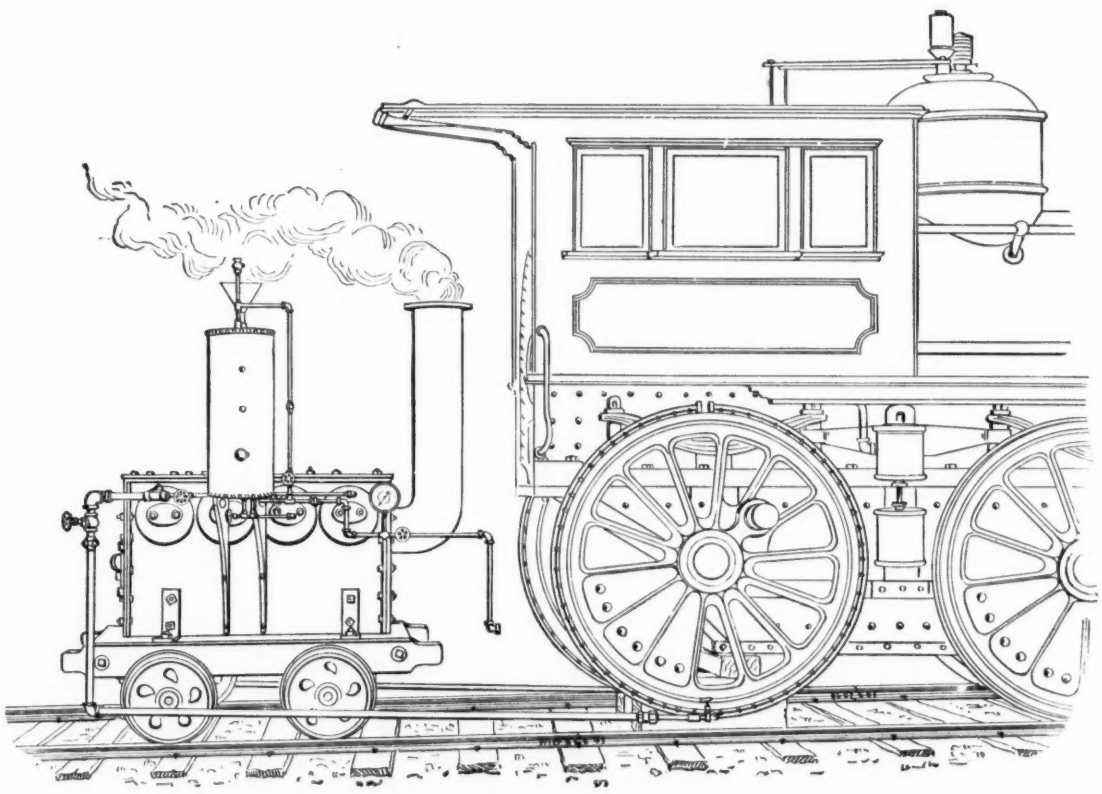
It is an innovation, in that but two tacks are used in lasting a shoe. It is known as the string machine, and about one dozen of them are at use in factories. —*Shoe and Leather Reporter.*

Apparatus for Heating, Setting and Removing Tires.

The device which we illustrate herewith, for the above-named purpose, is the invention of T. W. Gentry, master mechanic, and George W. O'Brien, general foreman, shops of the Richmond and Danville Railroad Company, and is made by Pedrick & Ayer, proprietors of L. B. Flanders Machine Works, Philadelphia, Pa. It can be arranged either as a stationary or portable plant. The cut shows general arrangement of the latter. The old process requires the wheels to be taken from under the engine and then run out to some safe place, where fires are built around them until they are hot enough to come off. This injures the paint and finish of the center, consumes much valuable time, and requires a good force of men, except where city gas can be introduced, and when this is possible, it is claimed that the plan shown is much cheaper and more satisfactory. In case of a loose tire, it is not necessary to take down the connections. In taking off or putting on new tires the connections are taken down. In all cases the engine is jacked up so that wheels will clear the rails about two and one-half inches to allow the burning hoop to be placed around the tire. This hoop is not a continuous ring of pipe; the ends are plugged up and are left a little space apart, so that they can be placed on the wheels while the connections remain on them. One of the main features is the generator, in which are four retorts, which are heated by fire of coke, coal or wood. Into one of these retorts oil is fed through a very small opening and needle-point valve. This generates gas, which passes into another retort. The two other retorts are for heating the air that is used with the gas, workings of which will be explained later on.

In close proximity is a tank, containing about ten gallons of common kerosene oil, and at any desired place is an air compressor that supplies air to the device. A very convenient arrangement is an air-brake pump, used for testing brakes, etc. Attachments are made to this oil tank, on top, so that an equal air pressure is on the oil that is operating on any part of the plant. This is controlled by a valve at will of operator. A larger connection is made with the two air retorts in generator, so that the air and gas are about the same temperature and are propelled by same force through generator. From generator to the burning hoop is made a connection through pipes out of which the gas flows, and in a fitting with an injector nozzle the air mingles with the gas and forces both through the burning hoop that has been placed around the wheel. On the inner side of this hoop small holes are made, about one and one-half inches apart. This hoop is held off from tire about one inch by small studs placed in hoop. After the furnace has been fired up and retorts are hot, air is admitted to them; also, the oil through needle-point valve, and in a few seconds gas can be admitted into the burning hoop and fired. The amount of flame is regulated by needle-point valve, and when tire is hot enough, shut off valve, the flame stops and the generator also. The gas is made only as fast as used, and is under absolute control. There is no waste and no danger. The points of pressure all have gauges and can be seen by operator. The flame that strikes the tire is a blue one and intensely hot, penetrating the tire very quickly. By placing generator out of doors, along a wall or any convenient place, no more danger need be apprehended than from an ordinary stove. The oil tank, manipulating valves, gauges, etc., are inside, close by the track that engine is run in on.

In regard to this device Mr. Gentry writes the manufacturers as follows: "The Richmond and Danville Railroad Company have, on their Western North Carolina Division, a number of ten-wheel freight engines, whose general condition is very good, with the exception of their tires. Driver brakes having been applied to all of them when last overhauled, their tires, which were about getting their last re-turning or truing-up at that time, have all proved too thin to stand; the friction and the heat thus generated have loosened up all of their tires. We find ourselves compelled to give all of these engines new tires, while the running gear and machinery is in first-rate order, and does not need coming down or being worked upon. It occurred to us that it would be an excellent opportunity to give our gas tire heater a good trial, so the new tires were ordered and specified to be of uniform outside diameters and free of flats, etc., with a view of being run without turning off on outsides. They came to hand, and we found them very nearly perfect, and as soon as the first engine arrived for her new tires, we chucked two tires on each of our double driving wheel lathes, and while tires were being bored out to fit wheel centers, we slipped off connecting rods, wheel covers and driver brake clogs or heads (nothing else was removed), jacked up engine until wheels swung over rails just enough to allow flange of new tires to slip over top of rail, and in from 10 to 15 minutes each we dropped off the old tires, and, by time the wheel centers were cooled off, the new tires were nearly ready to be applied. We had a suitable frame or heavy trestle, with a running hook and lever, which was placed in position in front of the wheel on which the new tire was to be placed; the tire was suspended in this, and the gas pipe arranged on it, and tires expanded and set in place on wheel centers on an average of less than 20 minutes each; or, in other words, the old tires were removed from six wheels and the six new tires put on, and the engine that came in in the morning to get an entire set of new tires, was ready for service that same evening. We consumed, in all, about 9 hours' time, and employed one machinist and six laborers in the gang. I wish to add, however, that the tires had only one light cut taken through them, and that I did not take into consideration the men who bored the tires, as this would have had to be done, no matter how tires were applied. This was our first attempt at removing and replacing whole sets of tires without removing wheels from the engine, and we desired to show that it could be done successfully and with great economy. We measured the oil consumed during the whole operation, and it averaged about half a gallon to an old tire, or three gallons for the six old tires, and a little more than three quarts for each new tire, or, say, about five gallons for the six new tires, making in all eight gallons at eight cents per gallon, making sixty-four cents for fuel. It is possible that a little more oil would have been consumed, had the old tires been very tight; but it is safe to say that $1 worth of kerosene oil will remove and replace six tires, no matter how tight they are. I might add that we find our apparatus so very convenient and cheap that it is now doing all the work connected with tire heating, setting, removing, shimming and replacing, and makes a hitherto disagreeable and uncomfortable job a picnic for the boys, being all indoors, and under perfect and easy control; and we can do any kind of work connected with tires, either under the engine or out on the floor."



APPARATUS FOR HEATING, SETTING AND REMOVING TIRES.

Liquid Fuel.

A further important advance has just been made in utilizing hydro-carbons for steam-raising purposes on board ship. A legitimate objection to the adoption of liquid fuel at sea under certain circumstances has been that the use of steam for the diffusion of the oil in the boiler furnaces entails a considerable loss of fresh water from the boilers. As this loss has to be made good by salt water on long ocean voyages, the density of the water is rapidly raised to a dangerous point. This is, however, entirely overcome by the system adopted in the steamship Charles Howard, owned by Alfred Suart & Co., which has recently been fitted with tanks for carrying refined petroleum in bulk, and also with Tarbutt's system of burning residual oils under the boilers in place of coal. She is 249 feet in length, with 30 feet beam and 23 feet depth of hold. The whole of the cargo space in the vessel is occupied by tanks for carrying the refined petroleum, while the refuse oil to be used for fuel is carried in the water ballast tanks. Her boiler is of the ordinary marine type, with three flues of 3 feet 6 inches diameter each. These flues are fitted with a brick combustion chamber and superheater, as in the case of other vessels fitted on the Tarbutt system. Another point of departure in the present instance consists in the substitution of highly heated and expanded compressed air for the steam ordinarily used in liquid fuel fires. The steam used for compressing the air is exhausted into the condenser, the water from which is of course available for feeding the boiler along with that condensed from the main engines. The Charles Howard left the Tyne dock last Saturday for the Black Sea, and as she steamed down the river at full speed, not a particle of smoke was visible from the funnel, the fires working admirably from the first start. It is stated that the owners propose to fit the remainder of their fleet with similar apparatus. The storage of the oil in the water ballast tanks has, we believe, never before been introduced in practice. It is an important feature, as it saves the shipowner the heavy expenditure incidental to the fitting of tanks in the bunker spaces, and, combined with the substitution of air for steam, marks a decided departure in liquid fuel practice.—*The Ironmonger.*

They Will Require Machinery.

There is going to be room for the establishment of a good many machine shops in the vast territory, now for the first time thrown open to settlement by the letter of instructions which President Cleveland has written to the Secretary of the Interior, in the test case made by the controversy over the ownership of "Guilford Miller's farm." There will also be calls on agricultural implement manufacturers all over the country for agricultural machinery with which to till these lands, to an extent that should perceptibly benefit the general business of the country.

The lands in question are situated in the so-called "indemnity" belts, within the limits of which the land grant railroads were, by the land grant laws, conditionally privileged to indemnify themselves for any deficiencies that might occur in the land grant belts absolutely ceded to them. For the past seventeen years the policy of the Government has been to keep these "indemnity belt" lands closed to settlement, until the convenience of the railroads is served—and they have not been in any hurry to prove their claims—although it is known that only a small portion would ever really be required for that purpose.

It is estimated that the territory which the President's order has virtually thrown open to settlers includes an area equivalent to the combined area of the States of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey and Delaware.

A Chicago machinery concern is experiencing special tribulation as the result of doing night work. So long as the shop worked by day only, there was no trouble, but night work was called for by the pressure of orders. Now a lawsuit has been brought by parties who live in the neighborhood and can't sleep o' nights on account of the clatter of hammers and other noisy machinery.

G. W. Cushing, for several years past superintendent of motive power of the Northern Pacific Railroad, has resigned his position to take charge of the mechanical department of the Philadelphia & Reading Railroad. Mr. Cushing is an accomplished railroad mechanic, who can be depended on to successfully handle anything he undertakes.

The only establishment in Findlay, O., that don't use natural gas is a saw-mill. They tried the gas, but found no use for their slabs, and went back to slab fuel again.

Suggestions in Machine Design.

A. J. Shaw.

EIGHTH PAPER.

Helical, or, as they are usually called, spiral springs, are more economical of material and space, for a given load and movement, than any other form, and, if properly proportioned, should be of indefinite durability.

Round wire is superior in every respect to wire of a rectangular or any other form of section. Not only does the saving over the square section amount to one-third the weight of the latter, but there is less danger of breaking down under heavy loads and great deflections.

As the stresses set up by the action of the load are almost entirely torsional, and as the maximum stress in any bar, for a given angular deflection, is proportional to the distance of the outer fiber of the bar from its center, it necessarily follows that the stresses are most evenly distributed for that section in which all the outer fibers are at an equal distance from the center. That section is the circle.

The most usual error in proportioning helical springs is in making them too short, or in putting in too few coils for the movement required.

Compression springs for long movements are often wound very open, and with but few coils, when, on the contrary, they should have a large number of coils, so as to distribute the deflection over a great length of wire.

The importance of this may be seen when it is considered that the stress set up by a given movement is proportional to the length of wire in the spring, or to the number of coils, the diameter of the spring and of the wire remaining the same. As will be seen by inspection of formula (3) below, the change in the diameter of the wire, in order that when the number of coils is increased or decreased, the movement may remain unchanged under a given load, varies as the fourth root of the ratio of the change in the length of the wire, giving, if there be an increase in the number of coils, a net gain equal to the three-fourths power of the number representing the ratio of that increase.

The elastic limit of tempered spring steel, and of hard drawn steel spring wire will range from 120,000 to 140,000 pounds per square inch, one-half of which, or 60,000 pounds, we may safely take as the maximum working stress.

The diameter of the spring should not be less than four or five times the diameter of the wire, in order that it may not be injured in coiling, and a larger diameter is desirable when it can be had.

Let N = the number of coils.
" C = the compression or extension of the spring, as the case may be.
" d = the diameter of the wire.
" D = the diameter of the spring to the center of the wire.
" W = the carrying capacity and
" W_1 = any load on the spring; and
" $l = \pi D N$ = the length of wire in the spring; then

$$N = 64 \frac{d}{D^3} C \qquad (1)$$

$$W = 23{,}500 \frac{d^3}{D} \qquad (2)$$

$$C = .000{,}000{,}2 \frac{W_1 D^3 l}{d^4} \qquad (3)$$

Formula (3) may be reduced to

$$C = .000{,}000{,}63 \frac{W_1 D^3 N}{d^4} \qquad (4)$$

These formulæ are reduced from those given by Reuleaux, which have been proven to be practically correct.

The reductions are based on a value of 12,000,000 for the torsional modulus of elasticity, and, as stated above, on a working stress of 60,000 pounds per square inch of section of the wire.

As an example of the method of using these formulæ, let us assume that it is desired to make a spring of round wire to carry a load of 100 pounds on a compression of 3 inches.

We will also assume that the diameter of the spring D shall be four (4) times the diameter of the wire or D = 4d, then by substitution in equation (2)

$$W = 23{,}500 \frac{d^3}{4d} = 5{,}875\, d^2$$

whence

$$d = .013 \sqrt{W}$$

and also from equation (1)

$$N = 64 \frac{d}{16\, d^3} C = \frac{4C}{d}$$

$$d = .013 \sqrt{100} = 0.13''$$

and

$$D = 4d = .52''$$

also

$$N = \frac{4C}{d} = \frac{4 \times 3}{0.13} = 92 \text{ coils.}$$

The length of the spring, closed, will be $92 \times .13'' = 11.96''$, say 12", and if it is desired that the spring shall just close under the 100 pound load the spring would be wound $12'' + 3'' = 15''$ long, whence the pitch of the coils is found to be

$$\frac{15}{92} = \frac{1}{6}'' \text{ nearly.}$$

If this length is too great it may be decreased by increasing the ratio $\frac{d}{D}$ or increasing the diameter of the spring. For instance, if the diameter of the spring be increased to eight (8) times the diameter of the wire or D = 8d, the diameter of the spring becomes nearly 1½", of the wire 0.184", while the number of coils required is reduced to 16, and the length of the spring is 3" closed, and 6" open.

If springs are to be subjected to suddenly-applied loads, causing oscillations, but one-half the maximum load given by formula (2) should be put upon them.

If flat springs are of uniform width, the side elevation should be a parabola, but an approximation sufficiently accurate for practical purposes in most cases may be made as follows:

Divide the length of the spring into four (4) equal parts; if the spring be fixed at one end and loaded at the other, or if it be loaded at the middle, consider each half as a single spring, the center being the point of fixture.

Then, if the thickness of the spring at the base be taken as 1, the thickness at each of the divisions will be

1, .87, .7, .5,

while the extreme end may be made .3.

If we assume the working stress at 60,000 pounds per square inch, as before, and the direct modulus of elasticity E at 30,000,000, then

$$W = 10{,}000 \frac{b h^2}{l} \qquad (5)$$

$$C = .000{,}000{,}2 \frac{W l^3}{b h^3} \qquad (6)$$

$$h = \frac{l^2}{500\, C} \qquad (7)$$

For example, take a spring 30" long to carry 100 pounds with a deflection of 6"; then

$$h = \frac{30^2}{500 \times 6} = \frac{900}{3{,}000} = 0.3''$$

By transposition of formula (5) we have

$$b = \frac{W l}{10{,}000\, h^2} = \frac{100 \times 30}{10{,}000 \times .09} = 2.7$$

The spring may be triangular in plan, in which case it will be of uniform thickness, the dimensions being determined by the same formulæ as in the above case.

The volute or clock spring is simply a flat spring coiled up, and its dimensions are determined on the same general principles as in the last case; but the formulæ require some modification, as the deflection is measured in angular instead of linear measure.

If we take R as the radius at which the load acts, and a as the angle in degrees through which the spring deflects, the working stress and modulus of elasticity remaining as before, we have the following formulæ:

$$W = 10{,}000 \frac{b h^3}{R} \qquad (8)$$

$$A = .00023 \frac{W l R^3}{b h^3} \qquad (9)$$

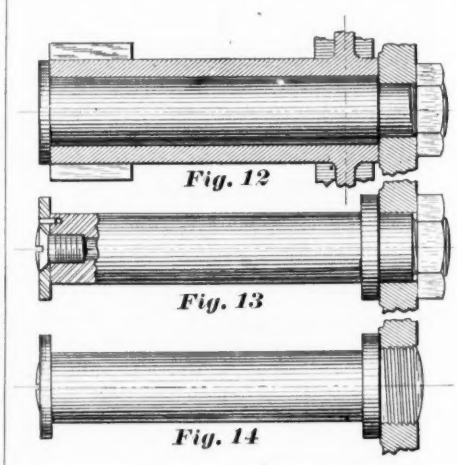


Fig. 12

Fig. 13

Fig. 14

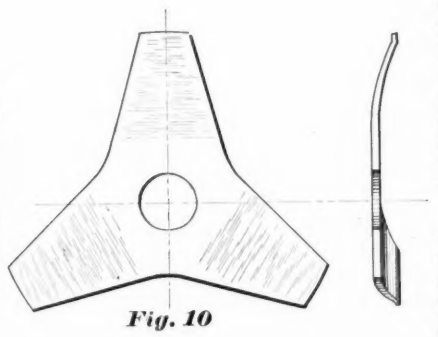


Fig. 10

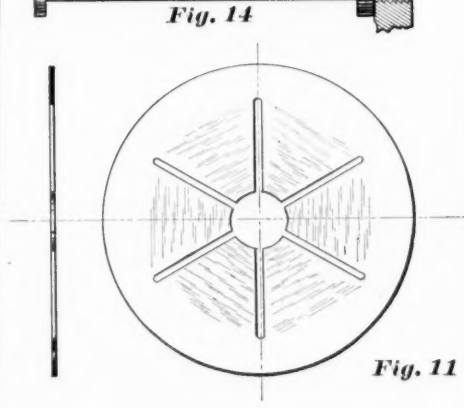


Fig. 11

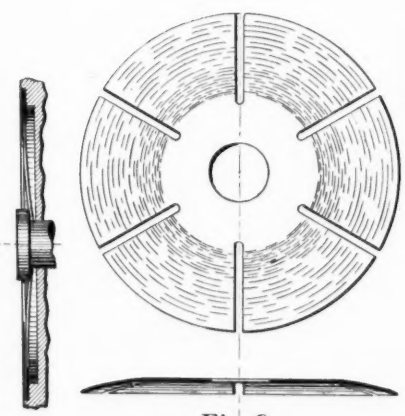


Fig. 9

Spring washers, as ordinarily constructed, consist of a dish washer with several cuts extending in from the outer edge, or are made with three or more projecting ends as shown in Figs. 9 and 10.

An improved construction which is applicable in many cases is shown in Fig. 11, which is substantially Fig. 9 turned inside out, the cuts extending from the center outward. The advantage consists in the better distribution of the metal, in that the parts which act as springs are widest at their bases, as they should be, while in the old form the reverse is the case.

While the improved washer can be dished if desired, it is better if made flat, as in that case the deflection is nearly uniform over the whole length of the spring portion, while if dished in the ordinary manner, the bending is concentrated at the base of the spring. Each section between the cuts, may, however be bent up, without injuriously affecting its action.

Especial attention should be given to the securing of long studs carrying loads at their outer ends.

The inner or fixed end should not be necked down to a small size as shown in Fig. 12, which is a not at all exaggerated representation of the rack pinion stud in the carriage of a lathe by a prominent maker.

This absurdity was perpetrated to avoid the loose washer at the outer end—a high price for a doubtful advantage.

Better constructions are shown in Figs. 13 and 14, the advantages of which, as to symmetry and strength, are so obvious as to need no enumeration.

An American in Russia and Central Asia.

A gentleman who has had an enviable experience from a traveler's point of view is Mr. George W. Sillcox, of 60 Barclay street, New York. He has spent several years in traveling to sell American agricultural implements, not only through every part of Europe, but through nearly all the inhabited portions of Asia, and several countries in Africa. He says American agricultural implements unquestionably lead the competition, though the British are strong competitors, and Germany is getting to be such in some lines, such as plows. Even in Siberia and the Tartar country, thousands of American mowing machines are bought yearly, as well as horse rakes and other implements. To see a Champion or other mower there at work, drawn by a single camel, is a very common circumstance.

Reapers and threshers are sold extensively in the wheat growing provinces of southern Russia. In the Kirghiz country in southwestern Siberia, adjoining Turkestan, lies a region comprising two million acres of as fine cotton land as there is in the world. Russian soil contains a wonderful wealth and variety of minerals. The region lying between Kharkov and Rostov, in the neighborhood of the river Don in European Russia, contains extensive deposits of anthracite coal.

Mr. Sillcox found traveling in central Asia, of course, under proper passports, safe, even in the Tartar and Cossack districts. Physically the inhabitants of these latter provinces are a splendid set of men. Credits are safer than most American manfacturers would think likely. An obligation expressed on Russian stamped paper, even though held by foreigners, is given the preference, in applying the assets of a bankrupt. Of course, special care is needed in selling; but losses from bad debts are not large. The climate of Siberia is much misunderstood in this country. It is a country of vast resources and extent, and the southern provinces enjoy a good climate and have an enormous area of fertile land.

Iron Manufacture and Longevity.

Two of the oldest iron manufacturers yet actively engaged in the business in Pittsburgh are Christian Zug, of the Sable mills, who will be eighty years of age on July 11th next, and Robert H. Marshall, of Graff, Bennett & Co. Mr. Zug, notwithstanding his age, has yet the vim of a hearty man in his prime. He has been in the iron business for forty-eight years. The late Jacob Painter was associated with him in the firm of Zug & Painter, and when they separated Mr. Zug took the Sable works and Mr. Painter the Southside works. Robert H. Marshall, the other of "the ancient and honorables" of iron manufacturing, has been in the business for forty-nine years, and at the age of seventy-three is yet an efficient manager. Usually men wear out in much less time of active life, but these two gentlemen are exceptions, and seem to be good for a score of years of work.—*National Labor Tribune.*

The Brenham (Tex.) *Weekly Banner* says very suggestively, speaking of the future prospects of that town:

Let any reasonable man, any property owner, any professional or business man or mechanic ask himself: What is Brenham doing to invite capital to her midst? There can be but one answer, Nothing. It is not reasonable to suppose that capitalists in search of a location are going to a town to invest money where the people themselves are doing absolutely nothing, and are making no effort to do anything.

Practical Drawing.

BY J. G. A. MEYER.

TWENTY-FOURTH PAPER.

FIRST PRINCIPLES IN DESCRIPTIVE GEOMETRY —CONTINUED.

228. Hereafter we shall have often occasion to refer to plane surfaces; indeed, these plane surfaces, or simply "planes" (see Art. 25) will play a very important part in that which is to follow. Therefore a few preliminary remarks in regard to planes may help some of our readers to obtain a clearer comprehension of the same. In Article 25 we see that a plane has length and breadth without thickness. Now, some of our readers may be thorough practical men, used to handle material things, and consequently may have some difficulty in forming a clear conception of geometrical planes —something which they cannot handle. To these we would say, that we cannot see any objections to the supposition that a plane is a very thin piece of material, say for instance a piece of tin, perfectly straight or true, and stiff that it cannot be bent, and under all circumstances remains true, and its thickness is not greater than the finest line that can be drawn, so that when a plane is passed through a physical solid (Art. 18) the plane will not remove any perceptible amount of material. Indeed, we may form a similar conception of a plane as we have of a line; namely, since a geometrical line has no breadth or thickness, it cannot be represented on paper by anything but a physical line, and in a similar way we may assume a geometrical plane is represented by a physical plane.

229. Let $A\ B\ C\ D$ (Fig. 168) be the vertical, and $A\ B\ E\ F$ the horizontal plane of projection, and $g\ h\ j\ k$ any plane standing perpendicular to the horizontal plane of projection, intersecting each other in the line $j\ k$; this line $j\ k$ is called the horizontal trace of the plane $g\ h\ j\ k$, or simply the horizontal trace. If the plane $g\ h\ j\ k$ is moved so that it will stand perpendicular to the vertical plane of projection, then the line in which these planes intersect each other is called the vertical trace; of course these traces will be straight lines.

230. If the plane $g\ h\ j\ k$ is parallel to the vertical plane of projection, as shown in Fig. 168, it will have but one trace, namely, the horizontal trace $j\ k$, and if the plane $g\ h\ j\ k$ be parallel to the horizontal plane of projection it will also have but one trace, and this trace will be on the vertical plane of projection.

231. The plane $g\ h\ j\ k$ may be placed in a position as shown in Fig. 169, that is, in an oblique position in which the plane will not be parallel to either plane of projection, but is parallel to the ground line $A\ B$; in this case the plane $g\ h\ j\ k$ will have two traces, namely the vertical trace $g\ h$ and the horizontal trace $j\ k$; and both traces $g\ h$ and $j\ k$ will be parallel to the ground line $A\ B$.

232. When the oblique plane $g\ h\ k$ is not parallel to the ground line, as shown in Fig. 170, the vertical trace $h\ g$ will meet the horizontal trace $g\ k$ in one and the same point g located on the ground line $A\ B$.

233. With the aid of planes we can readily find the projections of any given straight line. Thus: Fig. 171. Let $A\ B\ C\ D$ be the vertical, and $A\ B\ E\ F$ the horizontal plane of projection; $s\ t$ a given straight line in space which is parallel to the ground line $A\ B$; it is required to show the manner of finding the projections of the line $s\ t$.

Suppose that through the line $s\ t$ a plane $s\ t\ g\ h$ be passed perpendicular to the vertical plane of projection, then the trace $g\ h$ will be the vertical projection of the given line $s\ t$. Also suppose that through the given line $s\ t$ a plane $s\ t\ j\ k$ be passed perpendicular to the horizontal plane of projection, then the trace $j\ k$ will be the horizontal projection of the line $s\ t$. Now assume that the vertical plane of projection is turned around the ground line $A\ B$ till it coincides with the horizontal plane of projection, then these planes with the projections of the line $s\ t$ will appear, as shown in Fig. 172, in which the projections $g_2\ h_2$ and $j_2\ k_2$ of the line $s\ t$ are parallel to the ground line $A\ B$.

234. From this we learn that when a given line in space is parallel to both planes of projection, the projections of this line will be parallel to the ground line, and consequently parallel to each other. Also notice that since the projections $g_2\ h_2$ and $j_2\ k_2$ in Fig. 172 represent one and the same straight line, the ends of the line or points g_2 and j_2 must also represent one and the same point, and therefore according to Article 227 these points $g_2\ j_2$ must lie in one straight line drawn perpendicular to the ground line $A\ B$. Similar remarks apply to the points h_2 Here then we have another instance in which one view is directly under the other as it should be (see Arts. 208, 224, 227).

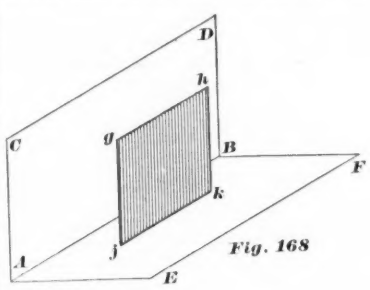


Fig. 168

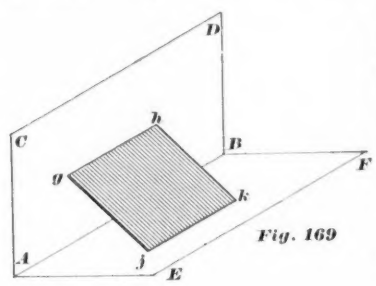


Fig. 169

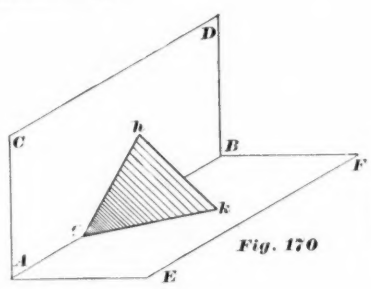


Fig. 170

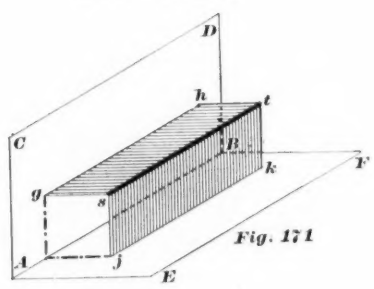


Fig. 171

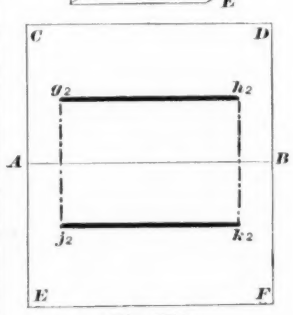


Fig. 172

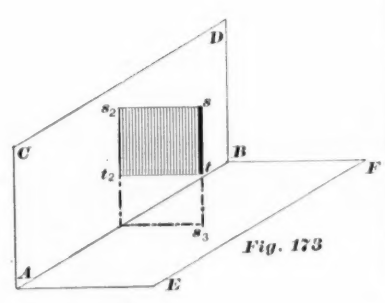


Fig. 173

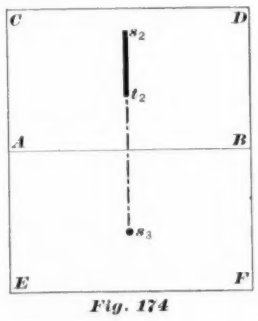


Fig. 174

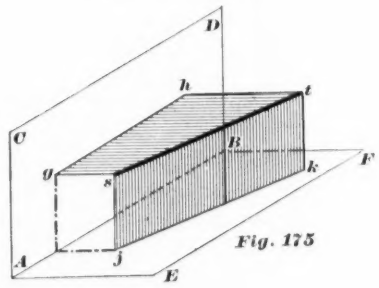


Fig. 175

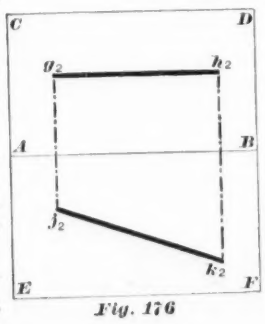


Fig. 176

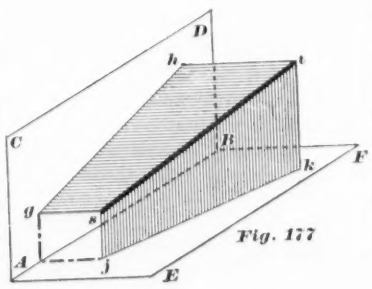


Fig. 177

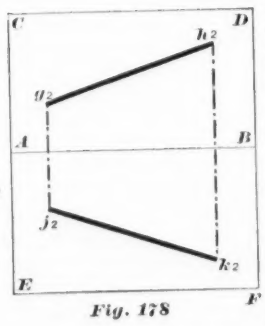


Fig. 178

235. If through a point lines are passed perpendicular to the planes of projection, these lines are called the projecting lines of that point; thus in Fig. 166 the lines $P\ P_3$ and $P\ P_2$ are the projecting lines of the point P.

236. The planes $s\ t\ g\ h$ and $s\ t\ j\ k$, Fig. 171, which have been passed through the line $s\ t$ are called the projecting planes of the line $s\ t$. The trace of the projecting plane perpendicular to the vertical plane of projection is the vertical projection of the given straight line; and the trace of the projection plane perpendicular to the horizontal plane of projection is the horizontal projection of the given straight line.

237. The foregoing principle can be stated in other words, namely: The projections of all the points of a given line on either plane of projection will make up the projection of the given line. Because the perpendicular lines drawn from all the points of a given straight line, to either plane of projection, will pierce the plane of projection in the trace of the projecting plane which contains these perpendicular lines.

238. Let it be required to find the projections of a given line $s\ t$ in space, such as shown in Fig. 173. In this figure the given line $s\ t$ stands perpendicular to the horizontal plane $A\ B\ E\ F$ and parallel to the vertical plane of projection $A\ B\ C\ D$.

In this proposition also, as in the previous one, we pass through the given line $s\ t$ a plane perpendicular to the vertical plane of projection; the trace $s_2\ t_2$ will be the vertical projection of the given line $s\ t$ (Art. 236). The horizontal projection will be simply a point, because when this line $s\ t$ is to be projected on the horizontal plane, all the projecting lines passing through the different points in the line $s\ t$ will coincide with this given line, and pierce the horizontal plane in one point s_3, which is the horizontal projection of the line $s\ t$ (Art. 237).

After revolving the vertical plane of projection until it coincides with horizontal plane $A\ B\ E\ F$, then these planes with the projections of the line on the planes will appear as shown in Fig. 174.

239. From this we learn that when the given line in space is perpendicular to one of the planes of projections, its projection on that plane will be a point, on the other plane of projection it will be line; and both projections of the given line must lie in one and the same straight line drawn perpendicular to the ground line, thus: The projections $s_2\ t_2$ and s_3 in Fig. 173 (which are the projections of the line $s\ t$ shown in Fig. 172) lie in one straight line drawn perpendicular to the ground line $A\ B$. Here again one projection is directly over the other.

240. Let it be required to find the projections of straight line $s\ t$, which is parallel to the horizontal plane of projection $A\ B\ E\ F$, but not parallel to the vertical plane of projection $A\ B\ C\ D$, as shown in Fig. 175.

Suppose that through the given line $s\ t$ a plane $s\ t\ g\ h$ be passed perpendicular to the vertical plane $A\ B\ C\ D$, the trace $g\ h$ of the projecting plane will be the vertical projection of the given line $s\ t$. Also suppose that through the given line $s\ t$ a plane $s\ t\ j\ k$ be passed perpendicular to the horizontal plane $A\ B\ E\ F$, the trace $j\ k$ of the projecting plane will be the horizontal projection of the line $s\ t$. Now notice since the given line $s\ t$ is parallel to the horizontal plane of projection, the projecting plane $s\ t\ g\ h$ must also be parallel to the horizontal plane $A\ B\ E\ F$, and, therefore, the trace $g\ h$ must be parallel to the ground line $A\ B$. Again, since the given line $s\ t$ is not parallel to the vertical plane of projection, the projecting plane $s\ t\ j\ k$ cannot be parallel to the vertical plane $A\ B\ C\ D$, and, therefore, the trace $j\ k$ cannot be parallel to the ground line $A\ B$.

241. From this we learn that, when a given line in space is parallel to one of the planes of projection, the projection of this given line on the other plane of projection will be parallel to the ground line. Consequently, after the vertical plane of projection has been turned around the ground line $A\ B$ till it coincides with the horizontal plane $A\ B\ E\ F$, the projections of the given line $s\ t$ will appear, as shown in Fig. 176. In this figure the projection $g_2\ h_2$ of the given line is parallel to the ground line $A\ B$, and horizontal projection $j_2\ k_2$ of the same given line is not parallel to the ground line $A\ B$.

242. Another very important fact should also be noticed, namely, the horizontal projection $j_2\ k_2$ (Fig. 176) shows us the correct length of the given line which has been projected, because the given line is parallel to the horizontal plane of projection; and since the given line is not parallel to the vertical plane of projection, its projection on this plane will not show the correct length of the given line. Consequently, if we wish to find out the correct length of this given line in space, we must measure its projection $j\ k$ in Fig. 176. From this the student must not conclude that, in order to determine the length of a line, he must always measure its horizontal projection; but he should understand that, in order to obtain the correct length of a given line in space, he must measure the projection on that plane of projection which is parallel to the given line.

243. In Fig. 177 we have shown a line $s\ t$ in space with the planes of projections; this line is not parallel to the vertical or horizontal plane of projection. We have also shown the projecting planes, whose traces are the projections of the given line $s\ t$. Fig. 178 represents the same vertical and horizontal planes of projection, as those shown in Fig. 177; but in Fig. 178 the vertical plane $A\ B\ C\ D$ coincides with the horizontal plane $A\ B\ E\ F$, and showing the projections of the given line in the correct relative positions to that of the ground line, and as will be noticed the projections of the given line are not parallel to the ground line. This indicates, as it should do, that the given line in space is not parallel to either plane of projection, and therefore the correct length of the given line cannot be obtained by measuring one or the other of its projections, and consequently to obtain the correct length of the given line we must employ a separate construction, which will be very soon explained.

244. From this we learn that if a given line is not parallel to either plane of projection, its length cannot be obtained by measuring the projections.

LETTERS FROM PRACTICAL MEN.

Pitting in Boilers.

Editor American Machinist:

In your issue of April 9th, Thomas Price asks a question in regard to pitting which I have been anxious to see answered. Our city has three Amoskeag fire engines that came with steel boilers with 1¼ steel tubes. The tubes became so badly pitted that they had to be removed and replaced with copper ones. The water in these boilers is kept constantly hot, from 180° to 220° F., but they are in use under steam pressure but a few hours in a year. Now this pitting takes place only commencing at water line and extending down from 10″ to 12″, and I find that other boilers in this locality which are being used for low pressure steam heat are attacked in the same way at and near the water line. Now for the cause. If the water we use here is put in an open vessel, and the temperature raised to 212°, there will be a thick scum on top; and my opinion is that this scum which is formed on top of the water while standing hot is (when a fresh fire is started and rapid ebullition takes place) carried down a few inches and attached to the metal, and there remains until corrosion takes place. If this opinion does not agree with other of your readers of like experience, I would be very glad to hear from them, for, like Mr. Price, I am seeking information on the cause of pitting and its remedy in steel boilers.

H. S. Tuttle.

[The question of the cause of pitting in boilers is a vexed one. If any of our readers can throw light on the subject, we should be glad to spread the information.]

The Utility of a Snow Bank.

Editor American Machinist:

One day recently two iron plates, each about 20 inches long, 4 inches wide and ½ inch thick, beveled on one edge like a ruler, were required to be case-hardened on the thin edge.

There was nothing at hand to hold water in which to immerse them. I knew, however, that out of doors, down stairs, on the ground, was a two-foot snow drift, and, doubting nothing, set to work. When one of the plates was properly heated, and the thin edge nicely covered with prussiate of potash, I carried it to the door at the head of the stairs, and threw it over the hand rail down into the drift. I immediately followed the plate—though by a different route—and by keeping snow on it hastened the cooling process. The second plate was treated in like manner. They were sprung a little, both alike, but were easily hammered straight.

J. E. McConnell.

Immersing Ties in Fresh Water.

Editor American Machinist:

On page 3 of your last issue you say: It is believed by many that railroad ties, immersed in fresh water for a month or two, will last twice as long as those not so exposed."

The above is the fact. Some thirty years ago I was engaged in bridge building, and all our specifications called for rafted timber. We found the immersion in the water would tend to abstract the albumen contained in the fresh-cut timber, and the result was that dry rot was to a great extent prevented. This was verified by the fact that parts of the same structure not being immersed commenced to decay long before that that was rafted or immersed in water.

W. Barnet Le Van.

Encouraging Steel Works.

Editor American Machinist:

I note what you say in regard to the fact that the Secretary of the Navy has contracted with American parties for a large amount of steel for the navy. Surely all American engineers and mechanics will give the Secretary due credit for taking such an important step in the encouragement of home industries.

I must still contend, however, that much more aid is wanted from our Government.

In the first place, the Bethlehem Iron Company, who are to make a large quantity of this steel, must, of course, add machinery to their already extensive plant, in order to produce this material in the time specified; whereas, if Congress had assisted the furnace and mill owners in years past, there would have been at present several large plants capable of doing any work required by our army or navy.

One of the most important items in metal, needed by every machine shop in the land, is a reliable steel casting that can be made from a regular pattern, such as is used for cast-iron. Such castings would largely take the place of forgings, and could be used for crossheads, connecting rods, piston heads, valve arms, rock shafts, all kinds of governor forgings, and all forgings used in machinist and wood-working tools and all classes of cast gearing. These castings should be made at a low cost. Steel castings that were not absolutely reliable have been sold during the past twenty years, all the way from 16 cents to 7 cents per pound; but very few of

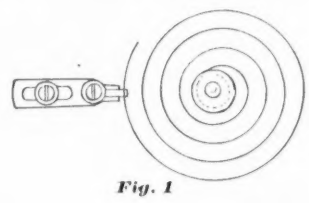


Fig. 1

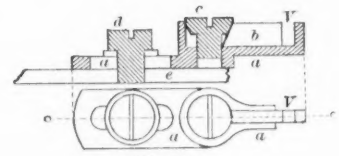


Fig. 2

them could be worked, even in the tenderest manner, at the forge fire.

I have lately seen several steel castings that would answer as a valve arm, crosshead, or a turning or planing tool.

Private capital and enterprise has developed this material, and the makers will perfect the system for all classes of work.

But this is expensive business, and I think such plants should be at all times patronized, or in some way encouraged by our national lawmakers, and this policy, in turn, will benefit the country at large.

W. H. Hoffman.

"The Hair Spring."

Editor American Machinist:

In the American Machinist of April 30, in an article entitled "Unhandy Machinery," some reference is made to the hair spring as to the best method of fixing it in a watch.

The importance of the subject seems to call for a more detailed treatment than is there given. The trouble with the present "pinning in" process is that the coils of the spring must generally be either expanded or contracted, in order to get the end of the outer coil to enter the hole in the stud; then the act of forcing the pins home in the collet and stud alters the curve of the inner and outer coils of the spring; this, of course, deranges the poise of the balance and spring. To counteract this derangement, recourse must be had to pliers and a process of secondary bending of the spring to bring it to its normal condition. This secondary bending process is, of course, a matter of guesswork, and frequently requires several trials and considerable patience to get the spring into a satisfactory condition. The object of this clamping system is to do away with all of this uncertainty and guesswork, and to enable the workman to fix the spring in the watch exactly right the first trial, so that coils of the spring shall retain exactly the same relation to each other after the spring is clamped in that they held when the spring was free.

Fig. 1 is an enlarged plan of the whole arrangement. Fig 2 shows the outer clamping device clearly in detail on a much larger scale. The central section is on the line *o*. The device consists simply of the body *a*, the clamping slide *b*, and two screws *c* and *d*. The screw *d* confines the device to the watch *e*; the screw *c* operates the slide *b*. An idea of the correct proportion of this device may be gained from the fact that the opening *v* in the jaw should not exceed the cross-section of the hair spring, the depth of the jaw being equal to the width of the spring; the extent of the movement of the slide *b* need not exceed the thickness of thin paper. In applying a hair spring to a watch with this device, the inner coil of the spring is first stamped between the collar and washer on the balance staff, as indicated by the dotted coil in Fig. 1. The balance is then adjusted in the watch in its working position. The device, Fig. 2, is then adjusted so that the jaw *v* shall receive the hair spring exactly at the right point, as shown in Fig. 1; the jaw must now be confined in this position by the screw *d*. The spring may now be clamped in the jaw *v* by turning in the screw *c*.

F. G. Woodward.

Size of Condensers.

Editor American Machinist:

I note answer to question 186, regarding size of condenser for a steam engine. The party who asked the question should have reflected that an answer was impossible. He might exactly as well have asked what quantity of water was required per horse-power per hour, and you could have answered from 16 to 120 pounds. The same variation would occur in the size of condensers, since they must, of course, be proportioned for the steam to be condensed, and this has no relation whatever to horse-power.

A few years ago I designed a condenser and air pump for a 200 horse-power engine, which worked in every way satisfactorily. Some time after that the parties for whom I made the design applied it to another 200 horse-power engine, and the results were quite unsatisfactory.

The reason was that the last mentioned engine used twice as much steam as the first one. If your correspondent will say how much steam he desires to condense you can undoubtedly give him a satisfactory answer, but when he speaks of horse-power it is as indefinite as "a piece of chalk."

Geo. E. Sloan.

Pittsburgh, Penn.

North and South vs East and West.

Editor American Machinist:

Did you ever work at a lathe or vise that was set against an east or west window?

If so, you know how unpleasant it is, in the hot summer mornings, to have the scorching rays of the sun streaming in upon you.

Any one who has tried it—and there are many, for shops are not always arranged for the comfort of those who work in them—will appreciate the luxury of a north or south window to work before, either in winter or summer.

In midsummer the sun is so high at noon that it cannot shine in a south window very far, and never sufficiently to dazzle the eyes.

The direct rays never come in a north window, and their sidelong glances in the early morning or late afternoon will not particularly inconvenience anyone.

Shops should, when possible, be built so that their length may run east and west, so that the larger part of the windows may be north and south.

H. R. Jones.

An Improvised Cupola.

Editor American Machinist:

In several numbers of the American Machinist its readers have had their attention called to the melting of iron under (what might be termed) difficulties, and a person not acquainted with the mystery of iron mixing and melting would be surprised at the many makeshift and odd contrivances got up to accomplish this feat of makeshift melting.

A furnace near this city had a break-down in their pumping machinery; the damage had to be repaired immediately, and the firm by whom I am employed received the order for the castings. The castings wanted were valve castings, and were to be finished that night. The order was received after casting, the cupola was not in condition, and it would not pay to fix it up for the amount of weight wanted. So it was decided to run the risk of melting some other way. A crucible holding about 150 lbs. was placed over the blacksmith fire, and was filled with light sprues. The iron was melted in five hours, and at 2 o'clock in the morning the castings were finished and were ready for the furnace. Of course the crucible looked rather sick, but then the castings weighed 45 lbs., and at one dollar per lb. the price covered all damages.

F. B. Shaffer.

Lancaster, Pa.

"Dishonest Practice in Boiler Making."

The following communication from an establishment engaged in the manufacture of engines and boilers, is so pertinent to the subject to which we called attention editorially in our May 7 issue, that we print it entire. We believe the sentiments contained in it will be heartily endorsed by first-class boiler makers everywhere:

American Machinist Publishing Company:

Inclosed we hand you an order for 100 copies of the American Machinist for May 7th, 1887. Your editorial on "Dishonest Practice in Boiler Making" is to the point, and deserves careful consideration by boiler users and boiler owners.

It has been a serious question with us whether we had not better close our boiler shop, and devote our time and attention to other more profitable departments of our business. An experience of over one-third of a century has taught us that nothing but the best stock obtainable should be put into a steam boiler, but with boilers made of charcoal solid flange and flange fire-box iron, and flange and fire-box steel, we have had no chance in competition with boilers made of inferior stock, though the saving of the difference in cost of the high grades and the low grades in many would have given us orders that went to other concerns using the cheaper grades. Are we not using too good stock? Would it not be about as well to use grades nearly as good and not so high-priced? These questions have been debated, and the answer has been "No, we will continue to use the best stock we can buy." Even if we could get rid of the feeling that we were in part guilty for the cause, if one of our boilers exploded and loss of life or damage to property ensued, a court would undoubtedly tell us, as it did a neighbor of ours whose boiler exploded within 48 days after it was put in use, and who had been sued for damages: "Belief that the stock you use is good enough for the purpose will not suffice; you must *know* it to be good and proper." So we will continue to use the best stock we can purchase until the end.

But the discussion turns on the necessity for a rigid inspection of stationary boilers by the National Government. It is a strange thought, that the people must appoint servants to protect the people from the consequences of their own cupidity and ignorance—more especially the former. Let any keen business man buy himself a pair of shoes. We will say he has a choice of two pairs—one priced $2.50, the other $3.50. Which pair does he purchase? The $3.50, of course. Why? Because he knows that no shoe of good wearing quality, such as he wants to wear, can be made and sold for $2.50. He suspects the $2.50 shoe the moment the price is named, notwithstanding its seemingly good appearance. Transfer the illustration to boilers. He is offered two boilers of a given size—one at $500, the other at $600. You may know, and we may know, that the $600 boiler is cheaper for him in the long run than the $500 boiler. You may know, and we know, that in the $600 boiler, with its first-class stock and its first-class workmanship, there is less profit for the builder than there is in the $500 boiler, with its inferior stock and its in-

ferior workmanship. We know that in cheap boilers there is a profit reminding one of "war prices." But which boiler does this keen business man buy? In nine cases out of ten the $500 boiler. Why? Because he does not know anything about different grades of stock, is assured by the builder of the boiler that it is "plenty good enough," and chiefly because he saves $100 on the purchase. If the boiler does fail him, he sees nothing ahead but a long bitter legal fight that may swamp him financially before he gets through. There is something to admire after all in the audacity of a boiler making concern which virtually says: "You had better not sue us for any damages for your exploded boiler. We have more money than you, and will let it cost us a small fortune before we get through with you. We will teach you boiler users not to come around here, talking suit about your exploded boilers!"

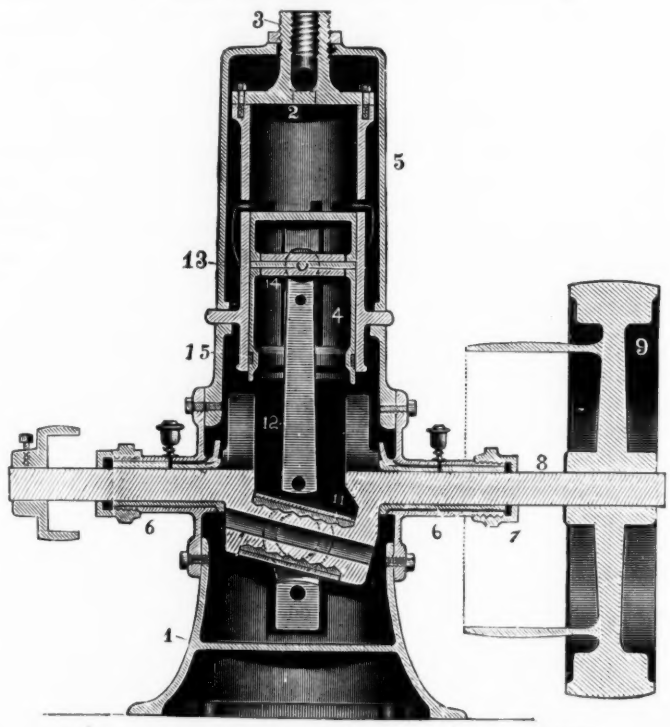
But to the point. Probably 75 per cent. of boiler purchasers know nothing, or very little, about the various qualities of iron or steel, and their particular adaptability or non-adaptability to use in boilers. Our stock is branded with the name known to the trade, and not with some special brand peculiar to the maker; further, we buy only of those concerns in which we have implicit confidence, and whose brands represent exactly the quality of the stock on which they are stamped. Our brands read: Charcoal flange, solid fire-box iron, or charcoal solid flange iron, or flange steel, or fire-box steel, according to the stock; bear the name of the maker and the place of business of the maker, and the tensile strength. We use no stock stamped with three crescents, or three stars, or three half triangles, or "homogeneous steel," or "cast steel—BB." But even with the brands legibly stamped in words, and not symbols, they are as meaningless to the average boiler purchaser, as the Egyptian hieroglyphics to a two-weeks-old apprentice in a foundry.

It is seldom in these days that a stationary boiler is sold except under specifications. Presumably, those specifications call for a good boiler, in both material and construction. The brand is noted among other details, but as just shown, the average boiler purchaser does not know the difference between different qualities of stock. For instance, "C. No. 1" tells him nothing more than "C. H. No. 1 flange." But an order is placed. One boiler maker will be honest; he will conscientiously live up to both the spirit and the letter of his specifications. When he gets the boiler made it is as good a boiler as can be made. The other boiler maker will be dishonest; he will disregard the spirit and evade as much of the letter of his specifications as quibbles will permit. When his boiler is completed, internally and externally it will bear the handprints of the knave that constructed it, and it is just such a boiler that mysteriously explodes in a Western saw mill, or from some unseen and unknown cause blows up and carries several near-by persons with it.

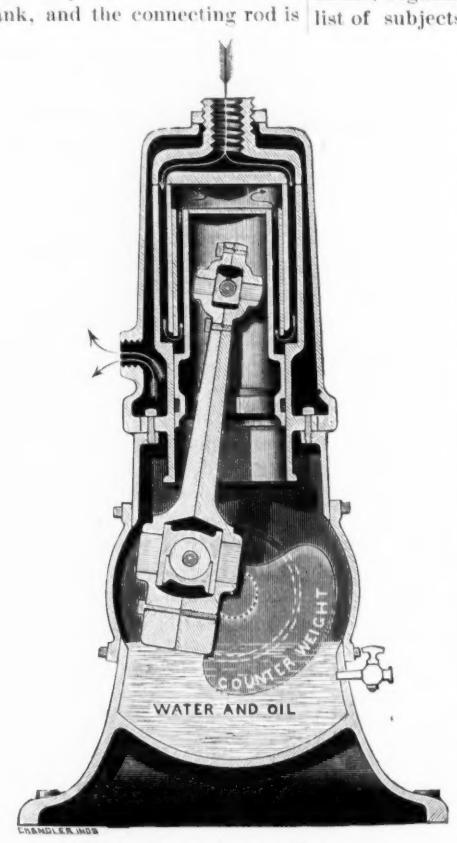
By all means, let us have Government inspectors who will as rigidly inspect stationary boilers as they do marine boilers. If an unscrupulous boiler maker insists on using a grade of iron or steel that is the cheapest in quality, as well as in price, then let the inspector decline to license those boilers, and very soon we will find this boiler maker either giving up business, or perforce doing honest work, and thus give boiler users, and those employed by boiler users, a protection from a criminality that springs from unscrupulousness and knavery, and is abetted by ignorance, or miserly cupidity, or a mixture of both.

These are but hasty ideas awakened by your editorial. They are not intended, by any means, as a discussion of all the elements that enter into first-class boiler making practice. We appreciate your article, as it coincides with our own views, and trust and hope the time is not far distant when your suggestions will be adopted, and a boiler inspector, backed by an authority springing from the Government, will be in attendance at our works to see that we build honest, reliable boilers. We feel confident we can pass examination.

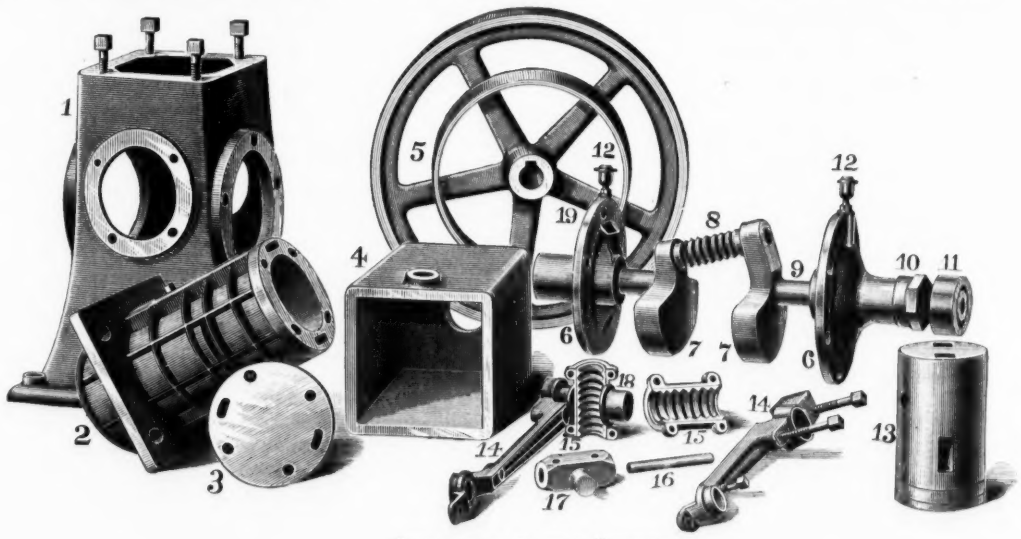
Woodbury Engine Company.
Henry H. Pryor, President.
Rochester, N. Y.



General Arrangement of Parts of Castle Engine.



Section of Castle Engine.



Details of Castle Engine.

The Castle Engine.

This engine has a vertical cylinder with a single-acting trunk cylinder. The oscillation that acts on the valve to open and close the ports is given by the angularity or divergence of the crank from the axial line of the shaft. This angle of the crank does away with the valves, eccentric and steam chest as ordinarily used, and reduces the number of parts to the fewest possible, and still retains all of the valuable features of the slide-valve, with a free exhaust, a constant lead and a fixed cut-off, with the advantage of having a balanced valve and one that cannot be tampered with.

Another feature of importance is the method of connecting crank boxes with the wrist-pin box, by what is in effect universal joints.

The lost motion is taken up by the parts themselves, from the pressure being constant in a downward direction in one stroke, from the pressure of steam upon the piston when doing work, and on the up stroke from gravity and the compression of the steam always holding the boxes against the crank-pin. A quiet, easy and noiseless movement is thus obtained at any speed.

The dimensions for the 5 horse-power main bearings are 5½ inches long, 2 inches in diameter; crank-pin, 5 inches long, 1⅝ inches in diameter; and these proportions are followed in all sizes. Genuine babbitt metal is used for the crank boxes, and gun metal bushes for the main bearings, insuring durability. The crank-pin is grooved, preventing any tendency to end motion of the crank box, also adding greater wearing surfaces.

The cylinder is placed in a direct line over the crank, and the connecting rod is equal in length to six cranks (standard).

The steam is cut off at from one-third to one-half of its stroke, having good benefit of expansion, and the exhaust takes place at the end of the stroke by the uncovering of annular ports around the cylinder, by the piston, carrying with it all the water of condensation.

The claim is made that this engine will run steadier under a load by reason that the speed being 400 revolutions per minute, it has 40 governing periods per minute as against 280 times per minute of the slide valve at 140 revolutions.

On the point of economy, the statement is made boldly that the Castle engine is more economical in the consumption of steam after years of use than the plain slide-valve form is when new. This is based on these propositions, assuming a condition of leakage of steam with the piston valve (which does not exist in practice but which is used for the argument), that using a vertical piston valve properly lubricated reduces the wear, which is further reduced by its own peculiar elliptical movement, and cutting off steam at ⅜ of its stroke and 400 revolutions per minute. That the leakage cannot equal ⅜ of a cylinder full of steam at boiler pressure, in one stroke or $\frac{1}{400}$ part of a minute, as this is the volume of steam expressed by the differences of cut-off between this and the slide valve form.

These engines are manufactured by the Castle Engine Works, Indianapolis, Ind.

Master Car Builders' Association.

The Twenty-first Annual Convention of this association will be held in Minneapolis, Minn., beginning June 14. Following is a list of subjects upon which special reports will be made, and which will be discussed:

1. Standards and appliances for the safety of trainmen.
2. British and continental practice in matters of interest to the Master Car Builders' Association.
3. Automatic freight car brakes.
4. The comparative advantages of the two methods of constructing freight cars, with and without platform timbers or end sills projecting from the end of the car.
5. Maximum outside dimensions of freight cars.
6. Standard draw-gear for non-automatic couplers.
7. Appliances to prevent the slipping of wheels, both passenger and freight.
8. Standard freight-car truck and axle for cars of 60,000 pounds capacity.
9. Standard sizes of lumber for freight cars.
10. The best form and construction of car roofs.

The revision of "The Rules Governing the Condition of, and Repairs to, Freight Cars for the Interchange of Traffic," will be the special order of business at 3 o'clock, P. M., on the second day, Wednesday, June 15, of the session of the convention. In order to take part in this revision, representatives of railroad companies must be members of the association.

Upon the best form of car roofs, the committee issued the following:

Your committee to report on the best form of car roof, at the annual convention to be held June, 1887, would respectfully ask your assistance in making up their report by giving them such facts as you may have referring to car roofs, particularly as to the name, plan of construction, material and amount used, cost of labor and material, average life, and any other information bearing on the subject that you may deem valuable.

They would kindly remind you that the value and importance of their report will depend largely upon your assistance in this way.

They will be pleased to receive your reply if possible not later than May 15, 1887.

Address to the Chairman,
J. D. McIlwain, Chairman.
G. T. R., London, Ont.
L. Packard,
N. Y. C. & H. R. R. R.
S. Irvin,
Mo. P. Ry.
Committee.

Additions now being made to Bessemer steel works in Pittsburgh will make the total Bessemer steel capacity of that city equal to the whole of France. Thus do we outstrip the old world.

The *Iron Trade Review* says:

"The machinists in Chicago, St. Louis, Kansas City, as well as in some of the smallest manufacturing towns of the West, find the rate of wages improving without the pressure of strikes. There is a demand for higher class of skilled labor in mechanical employments."

Eastern shop owners should advance prices on machinery, then raise wages.

AMERICAN MACHINIST

PUBLISHED WEEKLY

BY

American Machinist Publishing Co.

HORACE B. MILLER, Pres't.
JACKSON BAILEY, Vice-Pres't.
LYCURGUS B. MOORE, Treas. and Sec'y.
96 Fulton Street, New York.

JACKSON BAILEY, Editor. HORACE B. MILLER, Business Manager.

F. F. HEMENWAY, Mechanical Engineer.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 BOUVERIE STREET, Fleet Street, LONDON, ENG., will receive subscriptions for the AMERICAN MACHINIST, at 14/7 per annum, postage paid.

DEALERS SUPPLIED BY

The Albany News Company, Albany, N. Y.
The American News Company, New York, N. Y.
The Baltimore News Company, Baltimore, Md.
The Brooklyn News Company, Brooklyn, N. Y.
The Central News Company, Philadelphia, Pa.
The Cincinnati News Company, Cincinnati, Ohio.
The Cleveland News Company, Cleveland, Ohio.
The Colorado News Company, Denver, Colorado.
The Detroit News Company, Detroit, Mich.
The International News Company, New York, N. Y.
The Minnesota News Company, St. Paul, Minn.
The Montreal News Company, Montreal, Canada.
The National News Company, New York, N. Y.
The Newark News Company, Newark, N J.
The New England News Company, Boston, Mass.
The New Orleans News Company, New Orleans, La.
The New York News Company, New York, N. Y.
The Northern News Company, Troy, N. Y.
The Omaha News Company, Omaha, Neb.
The Pittsburgh News Company, Pittsburgh, Pa.
The Rhode Island News Company, Providence, R. I.
The San Francisco News Co., San Francisco, Cal.
The South West News Company, Kansas City, Mo.
The St. Louis News Company, St. Louis, Mo.
The Toronto News Co., Toronto, Ontario, Canada.
The Toronto News Co., Clifton, Ontario, Canada.
The Union News Company, New York, N. Y.
The Washington News Company, Washington, D. C.
The Western News Company, Chicago, Ill.
The Williamsburgh News Co., Brooklyn, E. D., N. Y.

SUBSCRIPTION.

$2.50 a year in advance, postage prepaid in the United States and Canada.
$3.50 a year to Foreign Countries, postage prepaid.

ADVERTISING.

Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.

EDITORIAL ANNOUNCEMENTS.

☞ *Positively we will neither publish anything in our reading columns for pay or in consideration of advertising patronage. Those who wish to recommend their wares to our readers can do so as fully as they choose in our advertising columns, but our editorial opinions are not for sale. We give no premiums to secure either subscribers or advertisers.*

☞ *Every correspondent, in order to insure attention, should give his full name and address, not for publication, but as a guarantee of good faith.*

☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from parctical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

NEW YORK, MAY 21, 1887.

CONTENTS.

	PAGE
The Park Injector	1
An Inventive Farmer	1
New Upright Drill	1
Newspaper Syndicates	1
Exhaust Tumbling Barrels	2
Washington Meeting of the American Society of Mechanical Engineers	2
Another Manufacturers' Union	2
A Feature in the Progress of Shoe Machinery	2
Apparatus for Heating, Setting and Removing Tires	3
Liquid Fuel	3
They Will Require Machinery	3
Suggestions in Machine Design. By A. J. Shaw. Eighth Paper	4
An American in Russia and Central Asia	4
Iron Manufacture and Longevity	4
Practical Drawing. By J. G. A. Meyer. Twenty-fourth Paper	5, 6
Letters from Practical Men—Pitting in Boilers. By H. S. Tuttle—The Utility of a Snow Bank. By J. E. McConnell—Immersing Ties in Fresh Water. By W. Barnet Le Van—Encouraging Steel Works. By W. H. Hoffman—"The Hair Spring." By F. G. Woodward—Size of Condensers. By Geo. E. Sloan—North and South vs. East and West. By H. R. Jones—An Improvised Cupola. By F. B. Shaffer	6
"Dishonest Practice in Boiler Making"	6, 7
The Castle Engine	7
Master Car Builders' Association	7
Locomotive Shop Notes	7
Compound Engines	8
Conduct of Railroad Officials	8
Mechanicians to the Front	8
"Get a Substitute for Beer"	8
One-Idea Towns	8
Questions and Answers	8, 9
Manufactures	9
Machinists' Supplies and Iron	10

Compound Engines.

It is only within a few years that American steam engine builders have shown any faith in compound engines; now nearly all prominent builders recommend compounding for large powers. The opposition to compound engines in this country is unaccountable, except upon the theory that the best American types of single cylinder engines for factory purposes seemed to leave but little room for improvement. Then the best writers here, until recently, were not inclined to favor expanding steam in more than one cylinder. This being so, as was natural, the disadvantages of compounding were made prominent, and, in a certain sense, passed into proverbs; this undoubtedly had an influence in prejudicing manufacturers.

Another thing is that no writer so far has ever been able to demonstrate with any degree of clearness why a compound engine was more economical in the use of steam. Woolfe, who patented a compound engine more than eighty years ago, set forth the advantages, which were based upon entirely erroneous ideas of expansion. Since compounding has come to be more common, a good deal has been written about less condensation, higher grades of expansion and the like; but no figures that can be satisfactorily used are submitted. But the fact remains that there is economy in compounding, and it is also a fact that manufacturers requiring large motive plants are coming to demand compound engines and high steam pressure in place of the typical simple condensing engine, working under moderate or low pressure. The old argument that it was foolish to use two cylinders for the work that one would do is very little heard now, although in view of the little that was known ten or fifteen years ago about compounding it had reason in it.

It is noteworthy that the demand for compound engines has grown up from actual observation of results, and not from any new scientific light on the subject, and that the compound engine has come to its present standing with steam users against a prejudice that was strong-seated. Whatever the theory may be, practice has shown that expansion can be profitably carried much further in two cylinders than in one.

The use of the compound engine in this country being based upon purely practical considerations, there is little doubt that for large power it has come to stay, especially since better regulation and more equal turning results from its use, which are often matters of great importance to manufacturers.

Conduct of Railroad Officials.

In one of the daily journals we find the following statement: "A train employe of a Western railroad says that it costs the men about five dollars per month the year round to chip in on presents to the officials of the road, and that he who refuses to chip won't hold his situation long."

Trainmen, not including conductors or engineers, generally receive from 40 to 60 dollars per month, while officials receive from $150 to $250 per month. If the salary of the officials is not sufficient to support them and their families, is it right for these officials to compel the employes, who earn only about one-half, and sometimes less than one-half that the officers do to make up the deficiency? If the salary of the officials is sufficient to support them and their families, then, why should employes, earning comparatively low wages, be forced to give five dollars per month to the high paid officials, or otherwise be discharged? Employes who receive 40 to 60 dollars per month, with large families depending upon them for support have nothing to spare to give away; unless they do as the conduct of the officials implies, that is, cut your slices of bread smaller, use less butter, or none at all, and buy inferior clothes for the family, but by all means keep up your contribution for presents to the officials, or you will be discharged. Now it appears to us that any official who will compel his men to pay a certain amount of money in order to hold their situations, is a man who cares nothing about the welfare of the employes, or the interests of the companies which employ him. Men of this class will discharge the employes who have regularly contributed to the presentation fund, just as soon as others can be found who are willing to contribute more freely. Officials who insist on compulsory contributions for presents are devoid of all honest principles, and as soon as sufficient evidence against these can be obtained, should be reported to headquarters, which will at once effect a telling reform so much needed on any railroad on which such dishonest practice exists.

Mechanicians to the Front.

The mechanician again comes in for more glory in the way of equipping modern armies for warfare. Both France and Germany are organizing corps of bicyclists and tricyclists for service in the field, in place of cavalry. Instead of scouring the countries for horses, it may be expected, in case of a war, that the makers of bicycles and tricycles will have their hands full to keep the modern "cavalry" mounted. The "cavalrymen" will not get unhorsed, but may expect to take an occasional header—we believe that is what they call it—and in place of denuding the country of grain and hay for his horse, he will only make an occasional requisition for a little axle grease.

"Get a Substitute for Beer."

We have received a letter from a Philadelphia subscriber, taking exception to a recent editorial bearing the above title, published in the AMERICAN MACHINIST. He thinks the views advanced in it unworthy of our pages, and refers to the high rate of mortality existing among beer drinkers.

We regret to observe that our correspondent seems to have misapprehended the purport of the remarks criticised by him. We wrote, not to encourage beer drinking, but with reference to the rapid and steady increase in the consumption of that beverage, and with special reference to the extensive use of it among workmen. Our correspondent's quarrel, therefore, is with the facts, and not with us. Noting the physical need of some kind of cooling drink felt by men engaged in hard labor in hot weather, with the resulting risk of forming a habit liable to last through the colder weather, we aimed to point out a direction in which temperance reformers, sincerely desirous to abate the drink evil, can do effective work, if they are willing to work with reference to the situation as it exists. We consider that temperance movements of whatever sort can have no more useful auxiliary than making available some practicable substitute for malt liquors.

One-Idea Towns.

One of the latest plans of that eminent financial engineer, Jay Gould, it is said, is to build a sort of patriarchal town, a few miles from St. Louis, and to locate the shops of the entire Missouri-Pacific system of railroads there. If he tackles this job seriously, he will, no doubt, carry it through, after a fashion; but he will be likely, in doing it, to add one piece of information to his sum total of knowledge, and this will be something he could never learn on Wall Street. It is that he will not be able to find the kind of workmen he would doubtless like to employ anxious to migrate to his imaginary Utopia. There is a laudable disinclination on the part of intelligent American workmen to submit to the supervision of their actions and manner of living outside the shop or factory that was part of the system of Russian serfdom, or that prevailed in primitive relations. They understand the necessity of controlling their actions in the shop according to established rules, but object to being governed by shop rules in the time that is their own.

It is fortunate that this is so. If each great industry in the country could contrive to make a little world of its employes, it would be the surest conceivable way to build up a nation of narrow-minded, unprogressive people. Men who, from force of circumstances, do one kind of work for a living, naturally have a good deal of interest in it; but they get unbalanced, or exceedingly narrow-minded, if they hear or talk of nothing else. It is unwise to discourage the acquisition of that general intelligence of men and things which is a characteristic of the American mechanic, and which he acquires largely by contact with men in all kinds of occupations and of all conditions in life.

Aside from this is the unwisdom on the part of workmen of putting themselves so much in the power of any man as they do by permanently locating where there is no possibility of ever being able to get other employment. In such a case there is sure to be a degrading feeling of dependence that would not exist if a change of employers did not amount to a practical impossibility, or at least to an expenditure that the workman does not feel justified in incurring.

The idea of dividing the people into clans in one-idea towns, with local despots at the head of each clan, is quite opposed to the American idea, and will never work satisfactorily, unless the country shall conclude to go back a few hundred years in the scale of civilization. The best that anyone ought to hope for every such scheme is failure.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(212) S. M. C., Markham, Ont., asks: Who makes foundry ladles to pour from the bottom? *A.*—We do not know of any one who makes such ladles.

(213) C. T., Jackson, Mich., asks: Was the tool described by Mr. Goodyear in the AMERICAN MACHINIST of April 23 used with or without water? *A.*—Without.

(214) R. J. C., Newark, Del., asks: How can I get cast-steel to stick to cast-iron, same as on iron vises? *A.*—See article on "Welding Steel to Cast-Iron." by Thomas D. West, AMERICAN MACHINIST, page 4, March 1st, 1884.

(215) Student, Indianapolis, asks: Will you kindly inform me what would be the force of concussion of a 25 pound-weight falling through a space of 12 inches? *A.*—See answer to question 211, AMERICAN MACHINIST, May 14th, 1887.

(216) A. S. M., Rochester, N. Y., sends samples of small bright corrugated washers, and asks: Can washers similar to these be made in black? *A.*—They can be made by any one in the business from sheet-iron, having about the finish of Russia iron stovepipe.

(217) J. S., Newark, N. J., asks: How is the pressure on an ordinary boiler tube calculated? *A.*—Find the surface of the tube in square inches and multiply this surface by the steam pressure per square inch, the product will be the total pressure on the tube.

(218) J. J. M., Rochdale, Mass., asks: What metal will expand the most and what the least by heat, and what will be the expansion? *A.*—For common metals see AMERICAN MACHINIST of April 30. If you want to use a costly metal, platina will expand about 3½ times less than zinc.

(219) W. K., New York, asks: Can you tell me the composition of a paste not likely to be affected by acids? *A.*—Melt together one pound resin, three ounces beeswax and four ounces red ochre, dried and warm. Add one ounce plaster of Paris, heating the whole to about the heat of boiling water.

(220) A. S., Chicago, Ill., asks: To whom shall I apply for information as to necessary qualifications to enter Cornell University? *A.*—A letter addressed Cornell University, Ithaca, N. Y., will bring you the information. It is not at all necessary to address any particular individual in cases of this kind.

(221) L. S. S., Colorado City, Tex., asks: Does water, from repeated use in steam boilers without aeration, lose any of its steam-making properties, and does its continuous use from any cause endanger the boiler? *A.*—Water will not lose its steam-making properties, or endanger the

boiler by continuous use. In steamers the water is continually used without any bad effects.

(222) C. H., Cleveland, Ohio, asks: 1. What power will a leather belt one inch wide carry, running 2,500 feet per minute? *A.*—Such a belt, if well arranged, should do 3½ horse-power work. 2. Can a metal band be arranged to run at the same speed without dangerous vibration, and what should be the size of pulleys? *A.*—There is not enough known about the use of metal bands to hazard an opinion. You will have to find out by experience.

(223) J. L., Indianapolis, Ind., writes: I have to speed up an engine from 140 to 150 revolutions per minute. The pulleys now are 7⅝ inches and 2¼ inches. The governor is a Pickering, marked 380. If I use a 3-inch governor in place of the 2¼ inch, will that give the right speed, and what does the 380 mark on the governor mean? *A.*—A 3-inch pulley will be practically correct. The number 380 on the governor indicates the speed at which it should be run.

(224) J. G., Philadelphia, writes: We have two bevel gears each 24 inches in diameter; one has wooden teeth, the other iron teeth. At present we are driving with the wheel having the wooden teeth, but we wish to change and drive with the iron wheel. What will be the difference in making this change? *A.*—The result will be the same in using the iron wheel, or the wheel with wooden teeth as a driver. The change you intend to make will not make any difference.

(225) G. F., Mobile, Ala., asks: 1. Why are the tubes of a surface condenser galvanized? *A.*—They are not always galvanized. When they are it is because the parties building the condensers think they will last longer for it. Tubes of surface condensers are very generally made of brass. 2. Is it necessary, in applying for a license, to get some other engineer to sign the application, or can I demand an examination without the signature? *A.*—You can demand an examination without any signature.

(226) V. G., Albany, N. Y., writes: 1. We are using soapstone facing for castings to be enameled. Those who enamel them claim that this is not best. What is better? *A.*—In our opinion, black lead facing is as good as any known 2. What is loam, used in making moulds? *A.*—Loam is a peculiar kind of earth used in making some kinds of moulds. If you will go into any foundry where they make such castings, as large steam cylinders and the like, you will be able to see for yourself.

(227) W. M., Montreal, Canada, asks: What is the best material of which to make rollers and shaft where there is a heavy strain? The roller is for a cam press to draw tin work. I have tried cast-iron rollers and cast-steel pins, soft and hard, and am now trying machinery steel rollers and hardened cast steel pin. What will give best results? *A.*—If it came to a case where we could find no combination to stand, we should try hardened steel pin and roller, ground to fit accurately, with just room between fit for oil.

(228) A. D. B., New Haven, Conn., writes: 1. I wish to make a boiler 40-inch shell, with a submerged head, and as short as possible without being too wasteful of fuel. How short can I make the tubes? Would 12 inches be too short, the tubes being 1½ or 1¼ inches in diameter? *A.*—It seems to us that tubes 12 inches long would be too short; 2 feet long, we believe, would be better, but to say so positively we would need more particulars. 2. How much lift should be given to air valves of the Westinghouse air pump? *A.*—The Westinghouse Air Brake Company make various sizes of pumps. To which do you refer?

(229) J. M., Buffalo, N. Y., writes: 1. I am hardening a lot of chisels, and after the temper is drawn I can rub off the color. Can you tell me what will retain the color? 2. How can I harden a steel blade 1-16 inch thick and 1″x6″, so it will not spring? 3. Can I, after I have hardened a knife ⅛″x2″x6″, straighten it while drawing the temper? *A.*—Mr. Goodyear replies to these questions: 1. Color on tempered steel will not rub off easily if, after hardening, the steel is made bright before drawing the temper. Look at clock and watch springs. 2. Use good steel which will harden at a low heat, and do not exceed the proper heat. Have the strain all out of the steel before heating for hardening. 3. Yes.

(230) L. D. T., Abilene, Kan., writes: It is necessary in our business to use large quantities of oil. Can you give me some good plan for constructing an oil filter that will be cheap and effective? *A.*—In a book on "Friction and Lubrication," by Professor R. H. Thurston, we find the following method for purifying oils: Oils which have been once used should be carefully cleansed before being again applied to bearings. Place in a tub holding 63 quarts, and having a tap inserted close to the bottom, and another about 4 inches higher, 7 quarts of boiling water, 3½ ounces carbonate of soda, 3¼ ounces chloride of calcium, and 3 ounces of common salt. When all these are in solution, 45 quarts of the oil to be purified are let in and well stirred for five or ten minutes; the whole is then left for a week in a warm place, at the expiration of which time the clear, pure oil can be drawn off through the upper tap without disturbing the bottom.

(231) J. V., Emporia, Kan., writes: Will you be kind enough to inform me through the columns of your paper where I can get a book on boiler-making that will teach me to lay out work. I am well versed in figures, and I am about six months out of my apprenticeship. I do not intend to do laborious work all my lifetime. Please inform me where I can get such a book, and what's the price of it? I have a book, but it is a treatise on sheet-iron work. If there is any to be got, I would like the best. *A.*—The development of surfaces, as in laying out boiler work, belongs to a knowledge of mechanical drawing. Any book that simply instructs you how to lay out the work pertaining to some particular boiler will be quite unsatisfactory. What you want to learn is how to lay out any kind of work, and this you will find out if you will carefully study the articles on practical drawing now appearing in the AMERICAN MACHINIST.

(232) A. B. C., Philadelphia, Pa., writes: 1. I am designing a triple expansion engine of 5,000 horse-power, to have four-feet stroke. What is the ratio of the three cylinders in practice, and must there be a proportion between the three cylinders, as in compound engines? *A.*—Unless you have studied the matter very carefully, you will not be likely to make a success of a triple expansion engine for a definite amount of work. The size of cylinders should be proportioned to the steam pressure and the work to be done; these sizes are determined largely by experiment. The proportions as given in the AMERICAN MACHINIST of May 7 are presumably about right for a steam pressure of 150 lbs. Sizes in proportion larger will give correspondingly higher power. 2. What piston speed is considered best for triple expansion engines? *A.*—With four-feet stroke we should assume that you could get about 600 feet piston speed. Make your largest cylinder about 15 per cent. larger than you would if it were a single-cylinder engine, to develop the power required at the rate of expansion you wish to employ.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Gear Wheels. See Geo. B. Grant's adv., p. 16.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Edw. Sears, Wood Engraver, 169 William st, N. Y.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Air Compressors, Rock Drills. J. Clayton, 43 Dey st., NY

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

Robbs' Patent Composition for case-hardening. Send for circular. F. W. Tasney, Paterson, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Extra capacity, hollow-spindle Hand Lathes; correspondence solicited. J. R. Rand, Brattleboro, Vt.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y

Best Spring Calipers and other Fine Tools; list free. E. H. Randall & Co., 154 Lake st., Chicago, Ill.

20″, 25″, 28″ B.G. and S. F. upright drills for immediate delivery. Currier & Snyder, Worcester, Mass.

Ice and Refrigerating Machines. 124 built, and all successful. David Boyle, 521 Monroe St., Chicago, Ill.

Drawing Materials, all kinds. Get catalogue. Mention this paper. G. S. Woolman, 116 Fulton st., N. Y.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 92 Park row, N. Y.

Complete sets of Castings for making small and medium-sized vertical engines; send for prices. Humphrey's Foundry, Bellefontaine, Ohio.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N. Y. Send for des'n.

New Book on Gears; Tables giving 3,094 diameters, with rules for calculation of movements of shafts, etc.; sent on receipt of P. O. Note; price 50 cts. Address C. B. Long, M. E., Worcester, Mass.

Catalogue of Books on Mechanical Engineering, Electricity, Arts, Trades and Manufactures, 116 pages, and monthly list of latest books, free of charge; can supply any book at published price. E. & F. N. Spon, 35 Murray st., N. Y.

"Indicator Practice and Steam Engine Economy.' By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2 post-paid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

MANUFACTURES

A stove foundry is being erected by Finch & Co. at Pamrapo, N. J.

The Empire Silk Company was recently organized at Paterson, N. J.

A company is being organized at Arcadia, Ky., to erect a cotton compress.

H. P. Dewey contemplates erecting a wood-working factory at Tullahoma, Tenn.

The Porter Manufacturing Company are building a cotton factory at Clarksville, Ga.

A $250,000 stock company is being organized to manufacture stoves at Knoxville, Tenn.

The Pratt & Whitney Company, Hartford, Conn., are employing 525 men, against 425 in 1886.

It is reported that Gibson, Lee & Co. are preparing to enlarge their stove foundry at Chattanooga, Tenn.

D. R. Wing & Co., Little Rock, Ark., are building a two-story addition, 50x140 feet, to their machine shops.

D. M. Scott, at Selma, Ala., is organizing a company to build car works. The capital stock will probably be $250,000.

The Blount Stave and Machine Company will erect a barrel factory at Chattanooga, Tenn. Work has been commenced.

A colony, composed of some 300 families, is leaving New England for Western Dakota, south of the Northern Pacific Railroad.

The Camden Woolen Mill Company has been organized at Camden, Me., and will put up a new mill, to be run by water-power.

The East Birmingham Sad Iron Works, Birmingham, Ala—capital stock, $25,000—has been organized, and will build the sad iron works.

The East Birmingham Land Company, Birmingham, Ala., are negotiating for the erection of a rolling mill, chain works, stove works, etc.

Findlay, O., is to have a rolling mill. It is to be moved from La Grange, Mo., and Messrs. Thorp and Andrews, of Findlay, own $100,000 of the stock.

The W. T. Adams Machine Company has been formed at Corinth, Miss., with $50,000 capital. They will operate the shop formerly owned by W. T. Adams.

The Sanderson Steel Works will be rebuilt, with additions, in Syracuse, N. Y. They will continue to make Sanderson English steel just as it is made in Sheffield.

The Eureka Manufacturing Company, 152 Lake street, Chicago, Ill., are receiving excellent commendations of the Queen's lubricant, manufactured by them.

According to the *Telegram*, of Grand Rapids, Mich., the town of South Boardman, Mich., offers twenty acres of land and a bonus and the privilege of a mill pond for a factory.

The Globe Yarn Mills, at Fall River, Mass., will probably put up an additional yarn mill, 300x90 feet, to contain 25,000 to 30,000 spindles. It will probably be in operation by fall.

Work has begun on a new mill to increase the capacity of the Pacific Mills at Lawrence, Mass. It will be 440 long and 74 feet wide, and its capacity will be 1,200 looms, with 250 operatives.

It is reported that a site has been donated to parties who will build a brewery at Florence, Ala. The Florence Land, Mining and Manufacturing Company can probably give particulars.

The Richmond (Va.) *Mercantile Journal* says Chas. L. Todd, of Richmond, has purchased the Gallego Mills Manufacturing Company's property for $120,000, and will soon put the works in operation.

The Betts Fencing Company, of Belleview, Fla., previously reported as contemplating erecting a fence factory, have purchased a site and will build a factory at once. Machinery is now being purchased.

The Bickford Drill Company, northwest corner Front and Pike streets, Cincinnati, O., have just issued a new and handsomely-illustrated catalogue of their upright drills. They report business good, with a large number of orders ahead.

The Calumet Iron & Steel Co., Chicago, have started up their splice-bar mill—a new acquisition to their already extensive plant at Cummings. The new mill is running full time, and is rolling out splice-bars at the rate of about 50 tons a day.

The new milling shop addition to the U. S. Armory at Springfield, Mass., will be erected on Federal square, extending east and west 280 feet on Lincoln street, in line with the machine shops in Armory square, and will be 36 feet wide on Armory square.

A. W. Carr, formerly connected with McNab & Harlin Manufacturing Company, and others have organized the A. W. Carr Company, and are erecting a large factory at Paterson, N. J., for the manufacture of brass cocks, whistles and similar goods.

The Eames Vacuum Brake Company, 123 Oliver street, Boston, has issued a new and elegantly-arranged circular of the devices made by them for applying their system of brakes to freight trains. It is one of the most complete and finely-printed and illustrated circulars we have seen.

S. S. Dunlap, J. H. Campbell, H. M. Wortham F. S. Johnson, John L. Culver, L. E. Culver and others have chartered the Macon Agricultural Works, at Macon, Ga.; capital stock, $25,000. Will build the agricultural implement factory reported last week.

Mr. Dorschuck, now with Lips & Claussen, brewers, is altering over the building formerly occupied by Frederick Prentice, as a hat factory, on Nostrand avenue, near Myrtle avenue, Brooklyn, N. Y., and will start a brewery. Considerable machinery will be required.

William Tod & Co., of Youngstown, O., are building for the Hartman Steel Company a machine for drawing 5″ steel shafting cold; also a straightening machine for the same shafting. Their shops are running 22 hours per day, principally on Porter-Hamilton engines.

The Burleigh Stocking Company—a stock company composed of Lowell and Boston parties—has been organized in Lowell, Mass. It has a capital of $115,000, and will begin the manufacture of all-wool hosiery very soon. At first the capacity of the plant will be 100 dozen stockings a day.

H. C. Heckendorn, Reading, Pa., has succeeded Heckendorn & Wilhelm. In addition to hat-making specialties, he has brought out a line of machine tools, consisting of engine and speed lathes, milling machines, planers, planer chucks, etc.; also pulleys, hangers and shafting.

The Medart Patent Pulley Company, St Louis, Mo., send us their 1887 illustrated catalogue and price-list of Medart wrought rim and other pulleys, clutches, hangers, pillow blocks, couplings and shafting specialties generally, together with rules for calculating sizes and instructions for ordering.

James Leffel & Co., Springfield, Ohio, have issued a new catalogue of steam engines and boilers manufactured by them. The catalogue is excellently well printed and illustrated. It contains illustrations of a number of engines and boilers, both horizontal and vertical, and is well worth perusal.

Ground has been broken for a brick addition to the E. W. Chapin mill, at Northboro, Mass., which will be 20x44 feet, the first floor to be used for drawing in warp and Berlin cloth, and the second floor to be used as a machine shop. Calvin Clisbee, of Marlboro, will do the carpenter work, and Houghton, of Westboro, the brick work.

And now it is Port Huron, Mich., that is booming itself as having an abundant natural gas supply, and expecting to become a great manufacturing center. Church & Co., a Brooklyn (N. Y.) firm of soda and saleratus manufacturers, have purchased a large tract of land south of the city, and will erect a factory. Other concerns talk of following suit.

The Pratt & Whitney Company, of Hartford, Conn., have recently perfected an exceedingly ingenious machine for the rapid manufacture of letter envelopes. The invention, protected by a number of patents in this country, has just been sold for a large sum to White, Corbin & Co., of Rockville, who have also placed with the Pratt & Whitney Company an order for the construction of several of the machines. White & Corbin are among the largest manufacturers of envelopes in this country, and it is understood that they contemplate substituting machines of the new pattern for those now in use by them throughout their extensive works.—*Boston Commercial Bulletin.*

The Curtis Regulator Company, of Boston, are doing an increasing business with their pressure regulators. Among those who have given them orders during the last month are Whittier Machine Company, Walker Pratt Manufacturing Company, Braman, Dow & Co., United Gas Improvement Company of Philadelphia (nine water and pump regulators and steam traps), U. S. Navy, Newport, London Rubber Company, Vermont Central for car heating, Pond Engineering Company, Martin's Anti-Friction Car Heating Company, United Gas Improvement Company of Philadelphia, Jarecki Manufacturing Company of Erie, and Porter Steam Heating Company of Minneapolis. This shows a good line of customers.

The National Pipe Bending Company, of New Haven, Conn., report an active demand for the National feed-water heater manufactured by them; also for the many styles of coils and bends of iron, brass and copper pipe. Among recent sales of heaters are Crompton Loom Works, 150 horse-power, Worcester, Mass.; Sioux City Brick Works, 80 horse-power, Sioux City, Iowa; Gallatin Bank, 100 horse-power, New York; North Attleboro Electric Light Company, 200 horse-power, North Attleboro, Mass.; Thomson-Houston Electric Light Company, 200 horse-power, Newark, N. J.; Sheffield Land and Coal Company, 80 horse-power, Sheffield, Ala.; Glasgo Yarn Company, 150 horse-power, Jewett City, Conn.; Citizens' Electric Light Company, Shenandoah, Pa.; State College, Orono, Me.; one 60 horse-power, to York, Pa.; two of 50 horse-power, to Minnesota; four 25 horse-power and two 90 horse-power, to New York city; one 25 horse-power and one 50 horse-power, to a Utah mining company; a 200 horse-power, to Brush Electric Light Company, Savannah, Ga.; a 150 horse-power, to Baltimore, Md.; a 200 horse-power, to Parkersburg Electric Light Company, Parkersburg, West Va.; a 150 horse-power, to Easton Electric Light Company, Easton, Md.; a 20 horse-power, to Scranton Corset Company, and 100 horse-power, to Scranton Forging Company; a 150 horse-power, to Rochester, Minn.; a 600 horse-power, to Pittsburgh Electric Light Company, Pittsburgh, Pa.

T. C. Harris & Co., 19 Federal street, Troy, N. Y., have established works at 19 Federal street, Troy, N. Y. They will furnish engines, shafting, pulleys, and do model work. They will also do blacksmithing, and do all kinds of sewing machine repairs.

Machinists' Supplies and Iron.

NEW YORK, May 5, 1887.

Iron—The prices for American pig are without quotable change. There is no intention on the part of large consumers to replenish stocks, and small buyers find no trouble in buying for immediate use. Prices range: North River brands, $21 to $21.50 for No. 1 X Foundry; $19.75 to $20.50 for No. 2 X; Grey Forge, $18 to $18.50.

Scotch Pig—Nothing is doing in Scotch brands except the filling of small orders. We quote: Coltness, $22 to $22.50; Gartsherrie, $21.50 to $22; Summerlee, $21.50 to $22; Eglinton, $20 to $20.50; Langloan, $21 to $21.50; Dalmellington, $20.50 to $21.

Lead—4.30c., with small demand.

Spelter—Refined, 5¾c. to 6c.

Antimony—Hallett's, 7.45c. to 7½c.; Cookson's, 8¾c.

Copper—Lake, 10c.

Tin—Banca in jobbing lots, 23c. to 23¼c.; Straits and Malacca, 22.85c.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Six first-class machinists on engine work; steady employment given. Address Box 29, AM. MACH.

Want to correspond with railroad parties desiring to engage a master mechanic of ability. Address A. M., AM. MACHINIST.

Wanted—A sober, careful man as foreman of a foundry doing large work. Address, with references, Henry, care of AM. MACHINIST.

A man with theoret. and practical experience wishes situation as designer or foreman of drawing room. Address M. E., AM. MACHINIST.

Position as foreman boilermaker by man thoroughly competent; has been foreman several years; best references. Address Box 32, AM. MACH.

Mech. Draftsman — A young Norwegian graduate from technical school, first-class mathematician, practical experience, wishes situation; best references. J. T., 235 Union street, Brooklyn, N. Y.

Wanted—Situation as foreman of machine shop; experienced in building automatic engines, etc.; first-class references. Address High Pressure, AM. MACHINIST.

A moulder, age 27 and married, experienced in jobbing shop and mill work, wants position where he can advance himself; railroad, engine or machinery work in South and West preferred; good references. Box 33, AM. MACHINIST.

A mechanical engineer and superintendent of long experience with steam and hydraulics, and general heavy machine work, is open for engagement; satisfactory references. Address D. E. H., AM. MACHINIST.

Wanted—Situation by a young man, aged 23 years, as patternmaker in an inland town not more than 100 miles from N. Y. city; has worked 7½ years on general machy. and engine work in New York city. Address B. L. W., AM. MACHINIST.

Machine shop foreman wanted to go South, accustomed to stationary engine work, general jobbing and steam fitting; must understand handling men to the best advantage, and be well advanced in modern machine shop practice; state wages expected and where last employed. Address Enterprise, AM. MACHINIST.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent solid lubricant, clean, durable, cheap; prevents hot boxes. Crescent Mfg. Co., Cleveland.

The Crescent automatic grease cup is adapted to every service. Crescent Mfg. Co., Cleveland, Ohio.

Light mach'y of all kinds built at short notice Edmund Mills, 8 Dey st., Jersey City Heights, N. J.

For Sale—A first-class boiler indicator, with alarms, with patterns and drawings. Address H. F. Logee, Stillwater, Minn.

Special tools and machines for mfg. designed and built to order; mechanical and Patent Office drawings. I. A. Weston & Co., Syracuse, N. Y.

For Sale—Low figure, in good order, four stationary engines—one each of thrty-five, forty, fifty and sixty horse-power. Address Pratt & Letchworth, Buffalo, N. Y.

Wanted — Manufacturer to make a patented wood-worker's tool, requiring grinding, polishing, forge, punch drill, tap mill and interchangeable work; permanent contract; forgings furnished if desired. Address Box 942, Minneapolis, Minn.

Designs and working drawings prepared for every branch of mechanical engineering; pumping machinery a specialty. A. C. Christensen, 26 Church st., N. Y. (late chief draftsman for Henry R. Worthington).

Patternmakers, Attention.—National Convention, Philadelphia, Penn., May 18, 1887. Elect your delegates promptly; give them clear instructions; save time; let it be a quick, clean job; wherever not organized, organize at once.

To Manufacturers—Desirable water-powers, with permanent dams and buildings, in a thriving, prosperous village, with good R.R. connections, to be had on most favorable terms; special inducements to reliable parties desiring to locate. Address J. W. Hall, Sec'y Business Association, Cazenovia, N. Y.

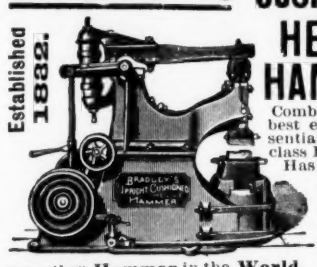
Wanted Superintendent or manager, who has ten to fifteen thousand dollars to invest, to take position in our established fdy. and mch. shops, now doing a nice business and located in New York State: must be able to handle men, and capable of influencing work to increase business; extra inducements offered to the right man. Address Business, AM. MACHINIST.

BRADLEY'S HEATING FORGES.

ESTABLISHED 1832.

For Hard Coal or Coke. Indispensable in all shops to keep **Bradley's Cushioned Hammers** and men fully employed and reduces cost of production.

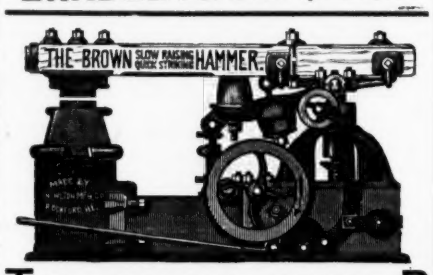
BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER



Established 1832.

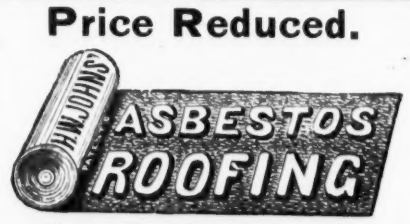
Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other **Hammer** in the **World.**

BRADLEY & CO. Syracuse, N.Y.



THE BROWN HAMMER
STRIKES A BLOW WITH
Double the Velocity That it Raises the Hammer.
A NEW MOVEMENT! SEND FOR DESCRIPTION.
KNOWLTON MFG. CO., KING ST., ROCKFORD, ILL.

Price Reduced.



FIRE AND WATER-PROOF BUILDING FELT, FIRE-PROOF PAINTS, STEAM PACKINGS, BOILER COVERINGS, ETC.

Samples and descriptive Price List free by mail.
H. W. JOHNS M'F'G CO., 87 MAIDEN LANE, N. Y.

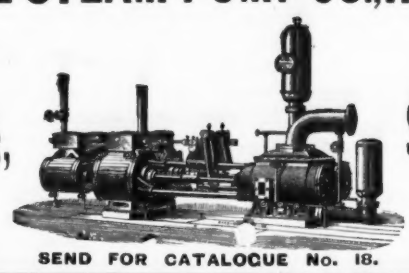
STEPHENS PATENT VISES.

ONE-HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular.
TOWER & LYON,
93 Chambers Str-et, New York.
Successors to MELVIN STEPHENS.

GEO. F. BLAKE MANF'G. CO.
BUILDERS OF EVERY VARIETY OF

95 & 97 LIBERTY ST., NEW YORK. 111 FEDERAL ST., BOSTON.
WATER WORKS PUMPING ENGINES A SPECIALTY

THE DEANE STEAM PUMP CO., Holyoke, Mass.
BUILD Water Works, ENGINES AND Steam Pumping MACHINERY.



SEND FOR CATALOGUE No. 18.

TRAVERSE SHAPERS.
15 inch stroke x 27 inch Traverse.
20 " " x 60 " "
30 " " x 72 " "

As noted above, we build 3 sizes of Traverse Shapers and can make the beds any desired length to suit special work. They are all stiff solid tools with a very deep bed. The two larger sizes have each 2 tables, a large heavy graduated swivel vise and automatic, vertical, angular and horizontal feed. The circular arbor also has independent feed. Screws and shafts are of steel and bearings are of hard bronze. The rack gear and pinion and other small gears are of steel. Our illustrated catalogue gives full description, and we shall be pleased to send them to those who are interested.

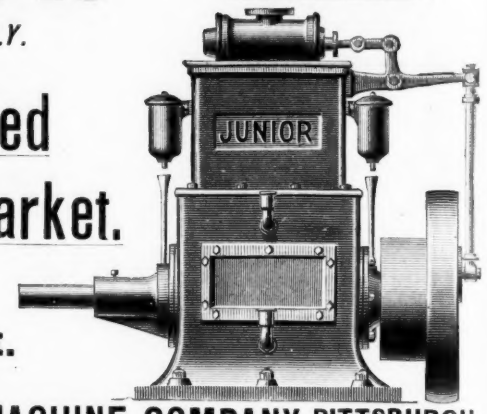
THE HENDEY MACHINE CO., TORRINGTON, CONN.

THE "JUNIOR" AUTOMATIC ENGINE.

15, 25 & 35 H.P. ONLY.

The Lowest-Priced Engine in the Market.

WELL BUILT AND SERVICEABLE.



The WESTINGHOUSE MACHINE COMPANY, PITTSBURGH, PA.

Sales Department for the United States conducted by

WESTINGHOUSE, CHURCH, KERR & CO., 17 Cortlandt St., N.Y., Hamilton Bldg, Pittsbgh., Pa.
FAIRBANKS, MORSE & CO., - Chicago, Ill
FAIRBANKS & CO., - - - St. Louis, Mo.
PARKE & LACY, - - - San Francisco, Cal.
IRON BAY MFG. CO., - - -

NICHOLSON FILE COMPANY, *Sole Mfrs. of*

FILES and RASPS Having the Increment Cut, also, FILERS' TOOLS and SPECIALTIES.

The above illustration represents a device in which files may be held for service in surface filing, and while in this condition READILY SPRUNG, in order to give at the will of the operator, more or less convexity to the working face of the file. It does away with unusual care to obtain a true convexity or "belly" to file sides, and in fact renders great service by enabling the operator to utilize the file to its full capacity.

SURFACE FILE HOLDER No. 4, Adapted to Hold Files 12, 13 14 in. Long.
" " " " 5, " " " 14, 15, 16 "

MANUFACTORY AND OFFICE - - PROVIDENCE, R. I., U. S. A.

THE HANCOCK INSPIRATOR.

THE STANDARD

BOILER FEEDER FOR ALL CLASSES OF BOILERS.

OVER 85,000 IN USE.

Send for Circulars and Price Lists.

THE HANCOCK INSPIRATOR CO.

OFFICE, 33 INDIA WHARF, BOSTON, MASS.

THE NEW "GRESHAM" PATENT AUTOMATIC RE-STARTING INJECTOR

"Invaluable for use in Traction, Farm, Portable Marine and Stationary Boilers of all kinds No handles required. Water supply very difficult to break. Capability of re-starting automatically, immediately after interruption to feed from any cause."

SEND FOR CATALOGUE. RELIABLE AND CHEAP.

Sole Manufacturers in the United States and Canada.

NATHAN MANUFACTURING CO.

92 & 94 LIBERTY ST., - - - NEW YORK.

ROOTS' Force Blast Rotary Blower

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED,
POSITIVE BLAST,
PERFECTLY BALANCED,
Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

S. S. TOWNSEND, Gen. Agt. } 22 Cortlandt St.
COOKE & CO., Selling Agts. } NEW YORK.

In Writing, Please Mention This Paper.

DROP FORGINGS

(IRON AND STEEL)

MADE TO ORDER AT LOW PRICES.

BRADLEY & PIERSON MFG. CO.,

Foot of CLAY STREET, NEWARK, N. J.

BOOKS FOR

SHEET METAL WORKERS.

The Sheet Metal Worker's Instructor for zinc, Sheet Iron, Copper, and Tin Plate Workers, and others Geometrical Problems; Practical and Simple Rules for describing the various Patterns. By REUBEN H. WARN, Tin Plate Worker. With Boiler Making, Mensuration of Surfaces and Solids, Rules for Calculating the Weights of Different Figures of Iron and Steel, etc. Elaborately Illustrated. 8vo - - - - - - $3.00

A Practical Workshop Companion for Tin, Sheet Iron and Copper Plate Workers; containing Rules for describing various kinds of Patterns used by Tin, Sheet Iron and Copper Plate Workers; Practical Geometry Mensuration of Surfaces and Solids; Tables of Areas and Circumferences of Circles; Japans, Varnishes, Lacquers Cements, Compositions, etc. By LEROY J. BLINN. 100 Illustrations 12mo. - - - - - - $2.50

Galvanized Iron Cornice Worker's Manual containing instructions in laying out the different Miters and making patterns for all kinds of plain and circular work. Also, Tables of Weights, Areas, and Circumferences of Circles. By CHAS. A. VAILE. Illustrated by 21 plates 4to. - - - - - - - - $5.00

☞ *The above or any of our Books sent by mail, free of Postage, at the publication prices, to any address in the world.*

☞ *Our large catalogue of Practical and Scientific Books, 96 pages, 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science as applied to the Arts, sent free, and free of postage, to any one in any part of the world who will furnish us with his address.*

HENRY CAREY BAIRD & CO.

Industrial Publishers, Booksellers, and Importers

810 Walnut St., Philadelphia, Pa., U. S. A.

CHARLES MURRAY

ENGRAVER ON WOOD

58 ANN ST. NEW YORK.

WHY THIS IS PUT HERE!

For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

NEW PULSOMETER,

THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.

More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

PULSOMETER STEAM PUMP CO., 83 JOHN STREET, N. Y.

FOR SALE OR TO RENT

FOR A TERM OF YEARS THE **"EXCELSIOR MILLS,"** in SYRACUSE, N. Y. Strong building, suitable for heavy manufacturing; well-lighted; over 100,000 square feet of flooring; 100 horse water power; 140 horse power steel boiler; engine; heavy shafting, accurately lined. Situated on the Oswego Canal, and reached by two Railroad switches. Two blocks from fire-engine house, and private call to fire department. Room with power will be rented. Apply to

J. W. BARKER, *Sec'y American Dairy Salt Co., Limited,* **Syracuse, N. Y.**

BEMENT, MILES & CO.,

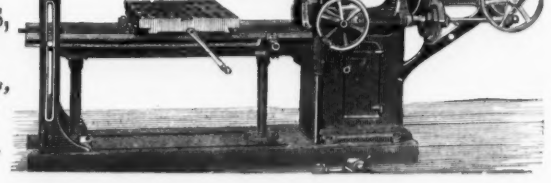
PHILADELPHIA, PA.,

BUILDERS OF

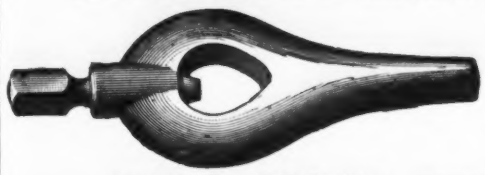
Metal-Working Machine Tools,

FOR

RAILROAD SHOPS, Locomotive and Car Builders, Machine Shops, Rolling Mills, Steam Forges, Ship Yards, Boiler Shops, Bridge Works, Etc., Etc.



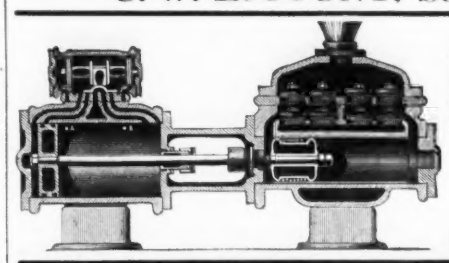
REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.



To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.



HALL DUPLEX PISTON PUMP

Simple,
Durable,
Efficient.

HALL STEAM PUMP CO.,

91 LIBERTY ST., NEW YORK.

THOS. D. WEST FOUNDRY CO., Cleveland, Ohio,

Manufacturers of Light and Heavy Iron Castings in Green, Dry Sand or Loam, also Machinery and Architectural Wood or Metal Patterns for Outside use. Patterns constructed durably and to mould in the most advantageous manner.

PARK MFG. CO.

34 Beach Street, Boston, Mass.

The Park Injector,

EJECTORS AND JET APPARATUS.

TO MANUFACTURERS, PATENTEES OR CONTRACTORS.

Estimates will be given and Contracts made by the Household Sewing Machine Co., for the manufacture of Machinists' Tools of any description. Will manufacture, under contract, Patented Specialties.

We are also prepared to do Japanning and Plating in large or small orders. Correspondence solicited.

ADDRESS,

HOUSEHOLD SEWING MACHINE CO.

PROVIDENCE, R. I.

For Pressure and Vacuum Gauges of every description, Exhaust Steam, and other Injectors,

Address, SCHAFFER & BUDENBERG,

40 John Street, New York.

BOILER MAKING

FOR

BOILER MAKERS.

A practical treatise on work in the shop, showing the best methods of Riveting, Bracing, and Staying, Punching, Drilling, Smithing, Etc., and the most economical manner of obtaining the best quality of output at the least expense.

BY W. H. FORD, M. E.

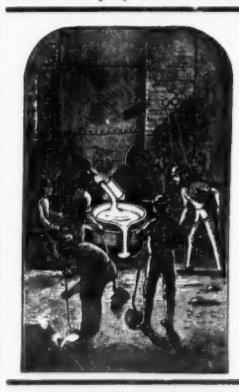
18mo, Cloth, - - - $1.00.

Published and For Sale by

JOHN WILEY & SONS,

Astor Place, New York.

Mailed and prepaid on the receipt of the price.



T. SHRIVER & Co's IRON FOUNDRY,

333

East 56th St.,

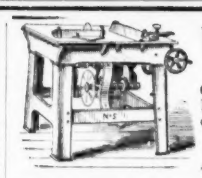
NEW YORK.

Contracts Solicited for Machinery Castings in regular supply.

No. 0. GRINDING MACHINE, FOR LIGHT WORK, TOOL GRINDING, ETC. TAKES EMERY WHEEL TO 12 IN. IN DIAMETER. ¾" ARBOR, AND PEDESTAL ON WHICH TO MOUNT ANY OF OUR SMALLER GRINDING MACHINES IN ABSENCE OF BENCH ORDINARILY USED.

38 and 40 Hawley St., Boston, Mass.

UNION STONE COMPANY,



Wood-Working Machinery

For Chair, Furniture and Cabinet Factories, Box Shops, Planing Mills, Pattern Makers' use, etc.

ROLLSTONE MACHINE CO.

45 Water St., Fitchburg, Mass.

E. P. B. SOUTHWORTH,

94 Exchange street, Rochester, New York.

Indicating Engineer and Mechanical Draftsman.

Correspondence solicited.

SHEPARD'S NEW $60 SCREW-CUTTING FOOT LATHE.

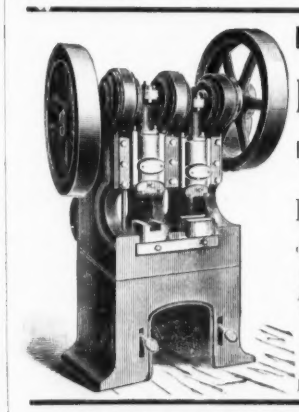
Gap Lathe, $125.

Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

Lathes on trial. Lathes on payment.

Send for catalogue of Outfits for Amateurs or Artisans.

Address, H. L. SHEPARD, Agent, 134 E. Second St., Cincinnati, O.



BEAUDRY'S DUPLEX Power Press

COMBINING

PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.

(Formerly of Beaudry's Upright Power Hammer.)

Sole Manufacturers.

Also manufacturers of HARD COAL HEATING FORGES.

Room 4, MASON B'DG,

70 KILBY ST.,

Boston, Mass.

WORTHINGTON Independent Condensers

ARE NOW IN USE ON ENGINES AGGREGATING UPWARDS OF

50,000 HORSE POWER

One of these machines—**the largest Independent Condenser in the world**—is applied to an engine of

8,000 HORSE POWER

SEND FOR ILLUSTRATED CATALOGUE

HENRY R. WORTHINGTON

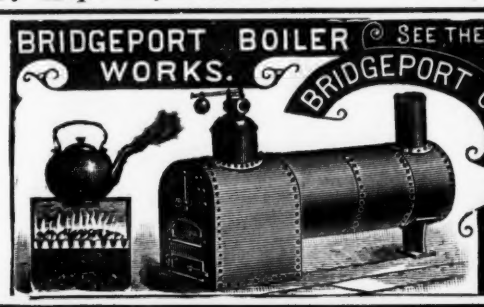
NEW YORK

BOSTON PHILADELPHIA

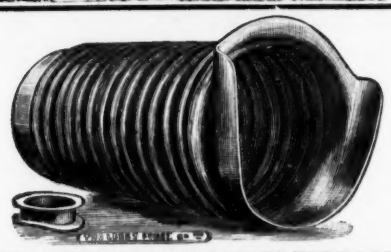
CHICAGO ST. LOUIS SAN FRANCISCO

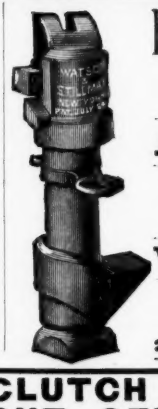
SAFE ECONOMICAL DURABLE BOILERS
HARRISON SAFETY BOILER WORKS. PHILADELPHIA. PA.
MERITS PROVEN 20 YEARS RECORD

"STEAM" A VALUABLE BOOK for EVERY STEAM USER AND ENGINEER
PUBLISHED FOR FREE DISTRIBUTION, BY
THE BABCOCK & WILCOX CO.
Manufacturers of
WATER-TUBE BOILERS,
107 Hope St., GLASGOW. 30 Cortlandt St., NEW YORK.

BRIDGEPORT BOILER WORKS. BRIDGEPORT CONN.

SEE THE IMPROVEMENTS IN STEAM BOILERS, BOILER FRONTS, BOILER FURNACES, AND FEED WATER HEATERS MADE AT THESE WORKS BEFORE BUYING STEAM PLANT. SEND FOR HISTORIES OF STEAM BOILERS AND FFED WATER HEATERS (FREE) ON MENTIONING THIS PAPER. WM. LOWE.

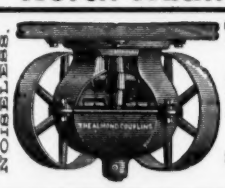
NEWBURGH STEAM BOILER WORKS. P. DELANY.
NEWBURGH, N.Y.
MANUFACTURER OF STEAM BOILERS OF EVERY DESCRIPTION
CARRY A LINE OF BOILERS IN STOCK FOR IMMEDIATE DELIVERY.

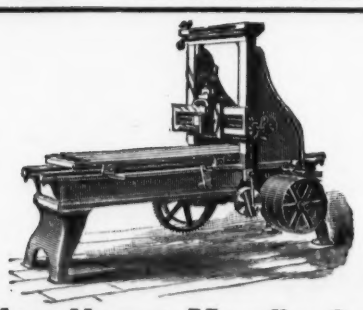

FOX'S CORRUGATED BOILER FURNACES
MANUFACTURED BY
THE LEEDS FORGE CO., Limited, of England
SAMSON FOX, C. E., Manager.
Best Yorkshire Steel (Siemens') Boiler Plates.
J. BEAVOR-WEBB, 41 BROADWAY, N. Y.
AMERICAN AND CANADIAN AGENT.


Hydrostatic Machinery
PRESSES, PUMPS, PUNCHES,
ACCUMULATORS,
JACKS, VALVES, FITTINGS,
Vault Elevators, &c., &c.
WATSON & STILLMAN,
204-210 E. 43d St., New York.

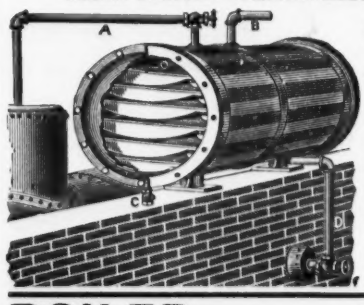
FRICTION CLUTCH PULLEYS AND CUT-OFF COUPLINGS.
JAS. HUNTER & SON,
North Adams, Mass.

J. WENDELL COLE, M. E.
Manager of Pennsylvania Southern Lake regions and the Northwest for
DETROIT EMERY WHEEL CO.
Address, Box 84, Columbus, O., or P. O. Box 152 Chicago.
Hart's Corundum-Emery Wheels.

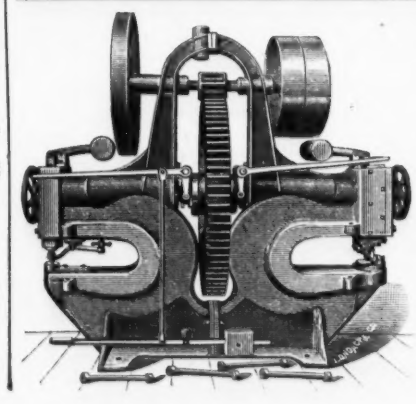

NOISELESS.
The Almond Coupling
A NEW quarter turn motion to replace quarter turn belts and bevel gears.
T. R. ALMOND, Mfr.,
83 & 85 Washington Street.
BROOKLYN, N. Y.


New Haven Manf'g Co.
NEW HAVEN, CONN.
IRON-WORKING MACHINERY.

ECONOMICAL STEAM BOILERS
A SPECIALTY.
SEND FOR PRICES. Pond Engineering Co. ST. LOUIS, MO.

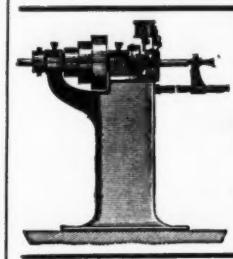
THE NEW HOPPES LIVE STEAM FEED-WATER
Heater and Lime Extractor.
CLEAN BOILERS GUARANTEED.

THE HOPPES MFG. CO.
SPRINGFIELD, O.
—Send for Catalogue D.—

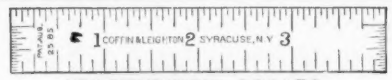
BOILER SHELL DRILLING MACHINE. FOR MARINE WORK.
SEND FOR CUT AND DESCRIPTION.
THOS. H. DALLETT & CO.,
500 N. 13th St., PHILADELPHIA, PA.


"THE ONLY PERFECT"
BUFFALO
Portable Forges,
The Lightest, Strongest, Most Durable, Easiest Working, and in every way THE BEST
Portable Forge Made.
Buffalo Forge Co.,
BUFFALO, N. Y.

JENKINS BROS. VALVES.
THE ENDORSEMENT OF FIRST-CLASS ENGINEERS AND MECHANICS THROUGHOUT THE COUNTRY has fully demonstrated these valves to possess the following advantages over all other valves now in use:
1.—A perfectly tight valve under any and *all pressures of steam, oils, or gases.* 2.—Sand or grit of any kind will not injure the seat. 3.—You do not have to take them off to repair them. 4.—They can be repaired by any mechanic in a few minutes. 5.—The elasticity of the Disc allows it to adapt itself to an imperfect surface.
In Valves having ground or Metal seats, should sand or grit get upon the seat, it is impossible to make them tight, except by regrinding, which is expensive if done by hand, and if done by machine soon wears out the valve, and in most cases they have to be disconnected from the pipes, often costing more than a new valve. The Jenkins Discs used in these valves are manufactured under our 1880 patent, and will *stand any pressure of steam, oils, or acids.*
JENKINS BROS., 71 John St., N. Y.; 105 Milk St., Boston.; 13 So. Fourth St., Phila.; 54 Dearborn St., Chicago.

WESTCOTT CHUCK CO., Formerly Oneida Steam Engine & Foundry Co., ONEIDA, N. Y.
Manufacturers of all kinds of
LATHE AND DRILL
CHUCKS.
Under Westcott's Patent.
Send for Catalogue.
Capacity Little Giant Improved.
No. 00 ..... holds 0 to 1/4 inch.
" 0 ..... " 0 to 1/2 "
" 1 ..... " 0 to 5/8 "
" 2 ..... " 0 to 1 "
" 2½ ..... " 0 to 1 "


William Barker & Co.
Manufacturers of
IRON AND BRASS
—WORKING—
MACHINERY
140 & 142 E. Sixth Street,
Nr Culvert, Cincinnati, O.
Send for circulars and prices.



MACHINISTS' SCALES,
Patent End Graduation.
We invite comparison for accuracy with all others.
Every Scale Guaranteed. Send for List.
COFFIN & LEIGHTON, SYRACUSE, N. Y.

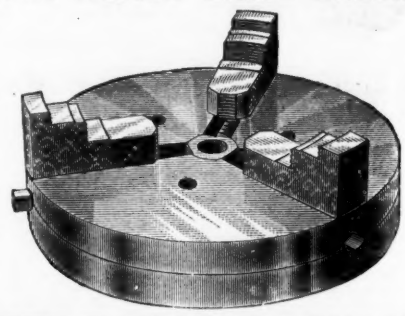
A Complete Cutting-off Machine, $4.00
Larger ones which cut to 2 in. $8.00
SENT ON TRIAL.

Drill Presses, Tap Drill Gauges.
STERLING ELLIOTT, Newton, Mass.

"CUSHMAN" CHUCKS
re guaranteed to be right in all respects. Ask to see them at your dealers, or write direct to the factory. Respectfully,
THE CUSHMAN CHUCK CO.,
HARTFORD, CONN.

HOOPER'S 70% GRATE BAR.

Will not Warp.
Will not burn off at the ends.
Will give absolutely 70% air space.
Will give uniform combustion of fuel.
Send for Circular and Price List to
ALEXANDER TRAUD,
EAST FERRY STREET IRON WORKS,
NEWARK, N. J.

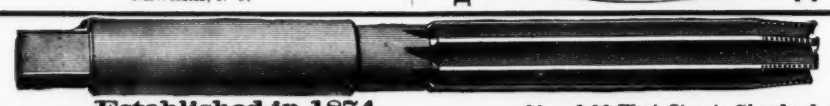
ESTABLISHED 1851.
The Horton Lathe Chuck.

THE E. HORTON & SON CO.
Canal St., Windsor Locks, Conn., U. S. A.

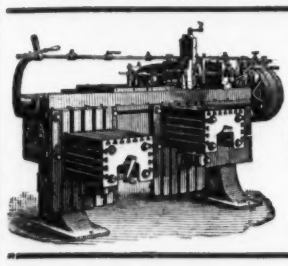
LINK-BELTING
AND
SPROCKET WHEELS.
LINK-BELT MACHINERY CO.
CHICAGO.
NEW YORK. MINNEAPOLIS.
Burr & Dodge, 125 N. 5th St., Phila.

DISCOUNT TO CLUBS. WRITE FOR FULL LIST.

HARDENED
STEEL SQUARES
and other
Fine Tools,
Manufactured by
STANDARD TOOL CO.
ATHOL, MASS.

STANDARD PUNCHES FOR IRON & STEEL PLATES.


Established in 1874.
CLEVELAND TWIST DRILL CO.
24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
85 Queen Victoria St., London, Eng.


RICHARDS' PATENT
Combination Planer and Shaper.
Several sizes, any length of bed. Only the head travels, the work remaining stationary. Combines advantages of both planer and shaper. Effective, durable and convenient. A number in use, giving perfect satisfaction. Send for circular. Manufactured by
E. A. WALKER,
75 Laurel Street, Philadelphia.

HILLES & JONES,
WILMINGTON, DEL.
PUNCHES & SHEARS
Improved Horizontal Punches.
A FULL LINE OF
BOILER-SHOP TOOLS.

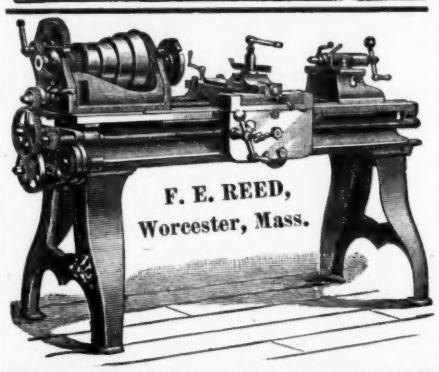
Morse Twist Drill and Machine Company, New Bedford, Mass.
Manufacturers of **Morse Patent Straight-Lip Increase Twist Drills.**

SOLID AND SHELL REAMERS, BEACH'S PATENT SELF-CENTERING CHUCK, BIT STOCK DRILLS.
DRILL GRINDING MACHINES, MILLING CUTTERS AND SPECIAL TOOLS TO ORDER.

STEEL BALLS
FOR ANTI-FRICTION BEARINGS,
OF BEST CAST STEEL.
HARDENED, GROUND & BURNISHED,
3-16" to 3" Diameter.
Samples and Prices on application.
SIMONDS ROLLING-MACHINE CO.,
FITCHBURG, MASS.

WELDLESS STEEL TUBES — QUICK OPENING GATE VALVE — COLD DRAWN
SMOOTH INSIDE & OUT.
JOHN S. LENG, 4 Fletcher St N.Y.

BEVEL GEARS,
Cut Theoretically Correct.
For particulars and estimates apply to
BREHMER BROS.
Machinists,
440 N. 12th St., Philadelphia, Pa.



F. E. REED,
Worcester, Mass.

MACHINERY
For Reducing and Pointing Wire.
Especially Adapted to pointing wire rods and wire for drawing.
For Machines or information, address the manufacturer.
S. W. GOODYEAR, Waterbury, Ct.

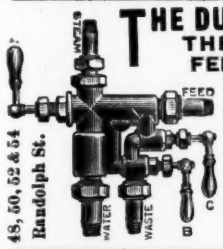
ENGINE Lathes, Hand Lathes, Foot Lathes, Upright Drills and Milling Machines. Agents, MANNING, MAXWELL & MOORE, 111 LIBERTY STREET, NEW YORK.

W. C. YOUNG & CO., Worcester, Mass. Manufacturers of
Engine Lathes, Hand Lathes,
FOOT POWER LATHES, SLIDE RESTS, Etc.

PRESSES, DIES AND OTHER SHEET-METAL TOOLS
FERRACUTE MACHINE CO. BRIDGETON, N. JERSEY U.S.A.

PRINT Your Own CARDS
PRESS, $8. Circular size, $8. Newspaper size, $44. Typesetting easy; printed directions. Send 2 stamps for Catalogue of Presses, Type, Cards, etc., to Factory.
KELSEY & CO., Meriden, Conn.

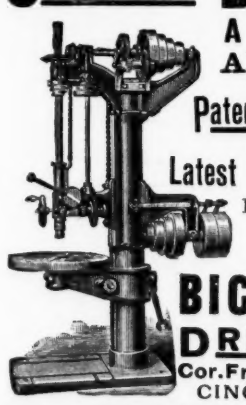
THE DUPLEX INJECTOR
THE BEST BOILER FEEDER KNOWN.



Not liable to get out of order. Will lift water 25 feet. Always delivers water *hot* to the boiler. Will start when it is hot. Will feed water through a heater. Manufactured and for sale by.
JAMES JENKS & CO.
Detroit, Mich.
48, 50, 52 & 54 Randolph St.

PATENT
PLANER and SURFACE GAUGE
An accurately graduated gauge by which planer and other tools can be quickly set at any height from the table or the work. Is also a convenient surface gauge. $3.75 each.
ARTHUR B. PHILLIPS, Manufacturer,
WHITMAN, MASS.

UPRIGHT DRILLS
A SPECIALTY.
ALL SIZES
—WITH—
Patent Quick Return
—AND—
Latest Improvements.
For Catalogues and Prices, address,



BICKFORD DRILL CO.
Cor. Front & Pike Sts.
CINCINNATI, O.

UNIVERSAL RADIAL and RADIAL DRILLING MACHINES
THREE DESIGNS, SIX SIZES.
EMBODY ALL DESIRABLE FEATURES.
PRICES $450.00 & UPWARD
ADDRESS UNIVERSAL RADIAL DRILL CO.
CINCINNATI, O. U.S.A.

SHAPING MACHINES
FOR HAND AND POWER.
6", 8" and 10" Stroke.
Adapted to All Classes of Work to their Capacity.
Circulars Furnished.
BOYNTON & PLUMMER,
WORCESTER, MASS.

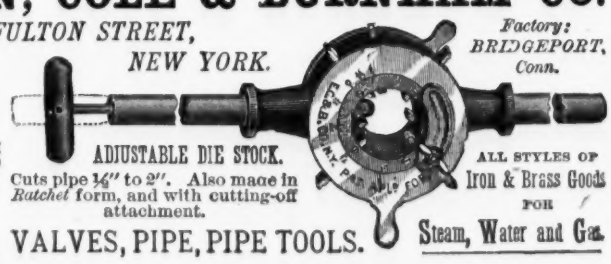
L. W. Pond Machine Co.
Manufacturers of and dealers in
Iron Working Machinery.
IMPROVED
IRON PLANERS
A Specialty.
140 Union St.,
WORCESTER, MASS.

NEW YORK AGENTS,
FRASER & ARCHER,
DEALERS IN
NEW AND SECOND-HAND MACHINERY,
Shafting, Hangers and Pulleys,
121 CHAMBERS ST.

DIXON'S
SILICA GRAPHITE
BOILER-FRONT AND SMOKE STACK PAINT.
WILL LAST FOR YEARS.
JOS. DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

CRANK PLANERS
Superior Design & Workmanship, Extra Heavy (1500 lbs.)
DOWN, ANGULAR AND CROSS-FEED,
TO PLANE 12x16x15.
THE R. A. BELDEN CO., DANBURY, CT.

THE EATON, COLE & BURNHAM CO.
82 & 84 FULTON STREET, NEW YORK. *Factory: BRIDGEPORT, Conn.*
MANUFACTURERS OF
Pipe Cutting and Threading Machines
OPERATED BY HAND OR POWER.



ADJUSTABLE DIE STOCK.
Cuts pipe ⅛" to 2". Also made in *Ratchet* form, and with cutting-off attachment.
ALL STYLES OF Iron & Brass Goods FOR Steam, Water and Gas.
FITTINGS, VALVES, PIPE, PIPE TOOLS.

D. SAUNDERS' SONS, Yonkers, N.Y.
MANUFACTURERS OF

Steam and Gas Fitters' Hand Tools.
SEND FOR CIRCULAR.
Pipe Cutting, THREADING, AND Tapping Machines.

THE PATENT WHEEL PIPE CUTTER shown in the cut combines simplicity with strength and lightness. Easily adapted to various sizes of pipe. Rolling instead of sliding motion. No loose parts to become detached and mislaid. All wearing surfaces are of tool steel, hardened. Less friction of parts than any other pipe-cutter made.

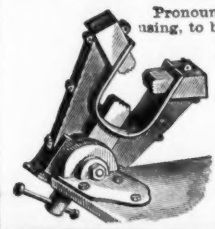
—OUR— NEW CATALOGUE OF TOOLS and Supplies sent free to any address on receipt of Ten Cents in stamps (for postage).
CHAS. A. STRELINGER & CO., Wood Ave., Detroit, Mich.

P. BLAISDELL & CO.
Manufacturers of
Machinists' Tools,
WORCESTER, MASS.

REGISTERED TRADE MARK — ELIAS HOWE, JR. — INVENTOR & MAKER NEW YORK U.S.A. — EMBODIED IN THE MACHINE

THE New Howe Mfg. Co.
BRIDGEPORT, CONN.
Mfrs. of Sewing Machines
Light and Medium Weight
Gray Iron Castings
OF ALL DESCRIPTIONS TO ORDER; ALSO,
TOOL MAKING, JAPANNING —AND— PLATING.
Correspondence Solicited.

CHALLENGE OPEN TOP PIPE VISE.
Pronounced by practical men, after using, to be the best ever invented.



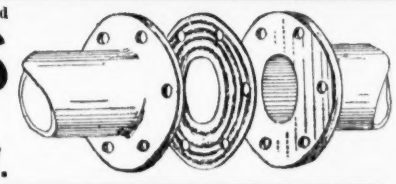
Sold by all Jobbers in New York, Chicago, Philadelphia, St. Louis, Pittsburgh, Canada.
Send for Catalogue "A."
ELGER & ELGER,
49 BROADWAY,
NEW YORK.

WALKER'S TOOL HOLDER.
For holding drills and reamers for lathe work. Prevents breaking or slipping. Can also be used for drilling and reaming holes by hand, and for reaming holes under drill presses, etc. Made with double handle, when required.

WALKER MFG. CO.,
CLEVELAND, OHIO.

MARCUS RUTHENBURG.
STEAM GENERATION.
MOTIVE POWER. STEAM HEATING
6th & W. 3rd St.,
CINCINNATI, OHIO.

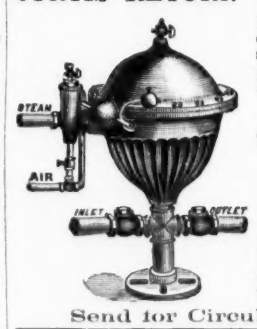
Joints made absolutely tight and durable by pat. corrugated
COPPER GASKETS
Furnished in all shapes and sizes for flanged PIPES, CYLINDERS, CHESTS, Etc.
Price List and Sample Free.
U.S. MINERAL WOOL CO., 22 Cortland St., N.Y.



Our Patent Rotating Fans are invaluable for Restaurants, Hotels, Meat Markets, Saloons, Lunch Counters, Groceries, Bakeries, Confectioneries, and in fact all places troubled with *heat* or *flies*. The only perfect Fan made that can be driven at any speed without disturbing the belt.
WE ALSO MANUFACTURE THE CELEBRATED BACKUS WATER MOTOR
Prices, from $6 to $35. Send for circular, to
BACKUS WATER MOTOR CO., NEWARK, N. J

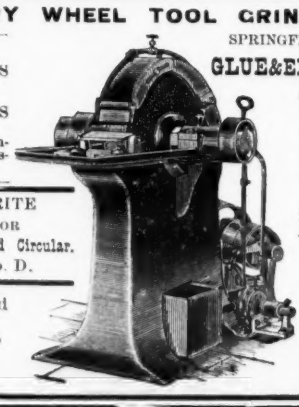
L. S. STARRETT,
Manufacturer of
FINE TOOLS
ATHOL, MASS.
SEND FOR FULL LIST.

CURTIS RETURN STEAM TRAP



For returning steam, condensed under pressure, automatically into the boiler, under high or low pressure,
Manufactured by
CURTIS REGULATOR CO.
Boston, Mass.
General Agencies:
109 Liberty St., N. Y.
66 N. 4th St., Phila., Pa.
108 5th Ave., Chicago, Ill.
210 S. 3d St., Minneapolis, Minn.
707 Market St., St. Louis, Mo.
Send for Circular No. 17.

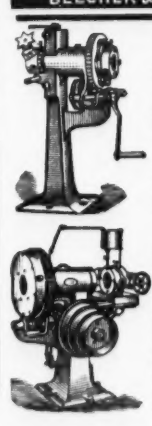
EMERY WHEEL TOOL GRINDER.
55 STYLES AND SIZES — Guaranteed Satisfactory.
WRITE FOR Illustrated Circular. No. D.
Patented Sept. 25, 1883.



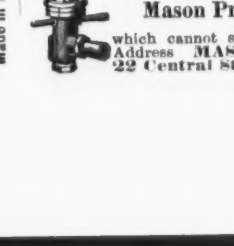
SPRINGFIELD GLUE & EMERY Wheel Co.
Springfield, MASS.
WATER PREVENTS THE HEATING.

PECK'S PAT. DROP PRESS.
NEW HAVEN
BEECHER & PECK, CONN.

DROP FORGINGS OF IRON OR STEEL
BEECHER & PECK, NEW HAVEN CONN.



"ECLIPSE" Pipe-Cutting Machines
FOR HAND OR POWER.
Don't you have sufficient Pipe-Work about your Mill, Factory, or Shops to make a powerful, convenient and very compact Pipe-Cutting Machine soon pay for itself, providing it could be had at a moderate price? Mention this paper and write us for particulars.
PANCOAST & MAULE, Philadelphia, Pa.
Made in Three Sizes, Cutting Pipes ¼ to 6 inch.

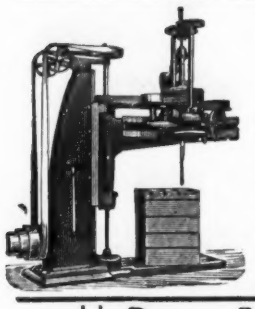


FORBES & CURTIS,
BRIDGEPORT, CT.,
Manufacturers of
The Forbes Pat. Die Stocks,
Power Pipe Cutting and Threading Machines, Cutting-off Machines, Ratchet Drills, Special Machinery, etc., etc.
WRITE FOR CATALOGUE.
Mention Paper.

S. Ashton Hand Mfg. Co., Toughkenamon, Pa.

Hand's Twist Drill Grinding Attachment.
Readily attached to any grindstone, emery or cutter-grinder. Grinds right and left hand drills from 3/16" diam. down to smallest sizes
PRICE, $20.

FIRE SPRINKLERS
Should always have their pumps equipped with the
Mason Pressure Regulator,
which cannot stick. All goods warranted
Address MASON REGULATOR CO.
22 Central Street, Boston, Mass.



WILLIAM SELLERS & CO. INCORPORATED

Engineers and Manufacturers of

IMPROVED MACHINE TOOLS FOR WORKING IRON AND STEEL

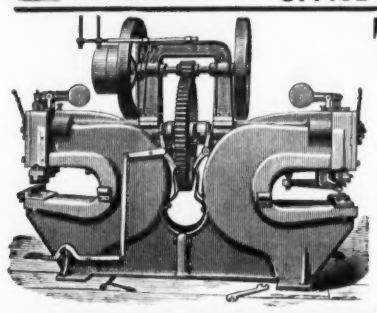
STEAM HAMMERS, PUNCHES and SHEARS, LATHES, PLANERS, BENDING ROLLS, BORING and TURNING MILLS. DRILL and TOOL GRINDERS, Etc., Etc.

SHAFTING, PULLEYS, HANGERS, COUPLINGS, Etc.

Improved Injectors for Feeding Boilers.

PAMPHLETS, PHOTOTYPES AND PRICES FURNISHED ON APPLICATION TO

OFFICE AND WORKS, PHILADELPHIA, PENN.



THE LONG & ALLSTATTER CO. Hamilton, OHIO.

Double, Single, Angle-Bar, Gang, Horizontal, Twin, Boiler, Spacing, Gate, Multiple, Belt and Steam-Driven

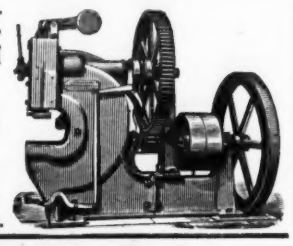
Punches and Shears.

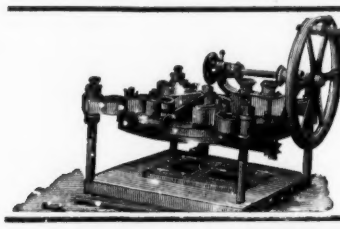
Over 300 Sizes.

ALSO,

Power Cushioned Hammer.

Send for new Catalogue.





Patent Portable Valve Seat Rotary Planing Machine.

Will Plane off the Valve Seats of Locomotive and other Engines without the use of files or scrapers.

Circulars with full description on application.

PEDRICK & AYER, - Philadelphia, Pa.

THE

Slate Sensitive Drill

Adapted to rapid work with small drills. Its extreme sensitiveness prevents clogging and breakage of drills. Has a switching table with attachment for center drilling. Instantly adjustable to different lengths of work. Over 200 already in use. Send for circular.

DWIGHT SLATE,

HARTFORD, - - CONN.

American Twist Drill Company's

PATENT CHUCK JAWS.

Three sizes. Price per set of 4 Jaws, $40, $48, $56. Bolted to lathe face plates, they make best and cheapest chuck in the world. Address orders, Laconia, N. H

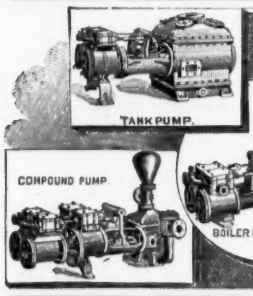
HILL, CLARKE & CO., Boston and St. Louis.
MANNING, MAXWELL & MOORE, N. Y. City.
TALLMAN & McFADDEN, Philadelphia, Pa.
or WM. BINGHAM & CO., Cleveland, Ohio

Iron and Steel

DROP FORGING

Of Every Description, at Reasonable Prices.

THE R. A. BELDEN CO., DANBURY, CT.



THE VOLKER & FELTHOUSEN M'F'G. CO.

MANUFACTURERS OF

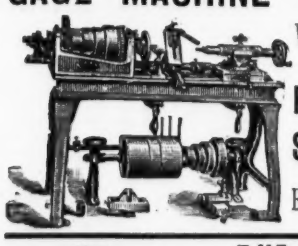
BUFFALO DUPLEX STEAM PUMPS.

CHURCH, BIRDSALL & MECHANIC STS. BUFFALO, N.Y.

For Sale at Factory Prices by

A. Aller, New York; S. C. Nightingale & Childs, Boston; Henry I. Snell, Philadelphia; Thos. J. Bell & Co., Cincinnati; Shaw, Kendall & Co., Toledo; Geo. Worthington & Co., Cleveland; N. O. Nelson Mfg. Co., St. Louis and Kansas City, Mo.; Goulds & Austin, Chicago; Kennedy & Pierce Machinery Co. Denver, Col.; Sheriff & Ashworth, Pittsburgh, Pa.; Jos. Baur, Manistee, Mich.; Jas. Jenks & Co., Detroit, Mich.; Wickes Bros., East Saginaw, Mich.; Adolf Leitelt, Grand Rapids; E. F. Osborne & Co., St. Paul, Minn.; Kruse & Barker, Milwaukee, Wis.; Joshua Hendy Machine Works, San Francisco; Flynn & Emrich, Baltimore, Md.; Forbes Liddell & Co., Montgomery, Ala.; Bailey & Lebby, Charleston, S. C.; O. B. Goodwin, Norfolk, Va.; Columbus Supply Co., Columbus, O.

GAGE MACHINE WORKS,



Waterford, N. Y

Manuf'r's of

Fox, Turret AND Speed Lathes AND Brass Finishers' TOOLS.

FOR SALE.

3-20 Inch Lever Feed Drills.
2-24 Inch Wheel Feed Drills.
1-24 Inch 2nd Hand Wheel Feed Drills.

Above Drills are ready for immediate delivery and following Boring and Turning Mills for quick delivery:

1-4 Foot Single Head Column.
1-5 Foot Single or Double Head.
1-8 Foot Single or Double Head.

H. BICKFORD,

Cincinnati, Ohio.

THE NATIONAL *FEED-WATER* HEATER.

A brass coil heater supplying feed water at 210° to 212° Fahrenheit by use of exhaust steam.

Our prices are low and reasonable, and we aim to supply the *cheapest, best and most effective Heater in the market.* Sixteen sizes. 10 H.P., $20; 100 H.P., $150; 500 H.P., $600. Iron, Brass and Copper Coils and Bends made to order. Circulars and price lists sent on application.

National Pipe Bending Co.

NEW HAVEN, CONN.

IRON LEVELS,

Manufactured by

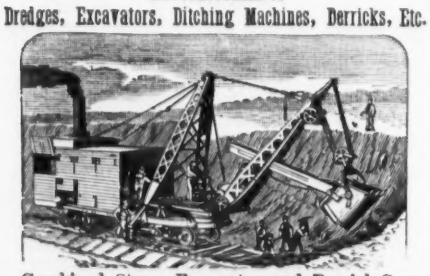
C. F. RICHARDSON, Athol, Mass.

OSGOOD DREDGE CO., ALBANY, N. Y.

RALPH R. OSGOOD, Pres. JAMES H. BLESSING, Vice-Pres. JOHN K. HOWE, Secretary and Treasurer.

MANUFACTURERS OF

Dredges, Excavators, Ditching Machines, Derricks, Etc.



Combined Steam Excavator and Derrick Car.

HERRICK & COWELL,

Manufacturers of

Drill Presses

POWER AND FOOT PRESSES,

Hand Lathes,

Paper Box and Special Machinery.

37 ARTISAN ST.,

NEW HAVEN, CONN

Send for Catalogue.

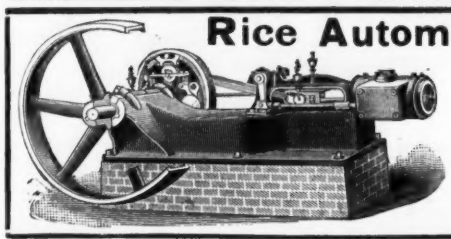
SOUTHWARK FOUNDRY & MACHINE CO.

PHILADELPHIA, PA.

General Machinists, Founders and Boiler Makers,

Heavy Machinery of all Kinds a Specialty.

Rice Automatic Cut-off Engine



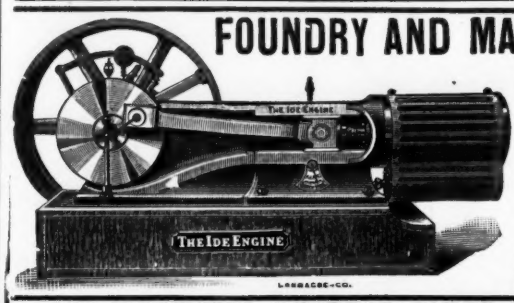
Self-Contained. Sensitive Governor. Balanced Valve. High Speeds. Stationary Oilers. Best Economy.

Gold Medal Cincinnati Exposition, 1884.

THE JOHN T. NOYE MFG. CO.,

BUFFALO, N. Y.

FOUNDRY AND MACHINE DEPARTMENT,



HARRISBURG CAR MFG. CO.

HARRISBURG, PA.

Highest Award Silver Medal AND Diploma AT FRANKLIN INSTITUTE NOVELTY EXHIBITION, PHILADELPHIA.

We are operating the finest and most successful Electric Light Stations in the world. A change of speed not exceeding one per cent guaranteed, running light and loaded. Send for catalogue.

IS A NATURAL PRODUCT TAKEN FROM OUR OWN MINES.

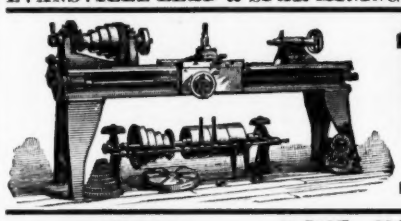
Unlike the manufactured products heretofore offered. We guarantee its success, if directions are followed, or *ask no pay.*

Send for Circular, Prices

FLUOR SPAR **The Best** and Experience of Users. **FOUNDRY FLUX**

Only 8 or 10 lbs. per ton of iron required to purify the iron. Will more than pay for itself in keeping cupola clean.

EVANSVILLE LEAD & SPAR MINING CO., Succ'rs to B. Burbank & Co., EVANSVILLE, IND.

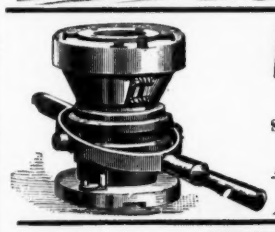


16" ENGINE LATHES

New Designs. First-class Workmanship.

THE MULLER MACHINE TOOL CO.,

Evans and Eighth Streets, - CINCINNATI, O.



ACME MACHINERY CO.,

CLEVELAND, OHIO.

Manufacturers of

"ACME"

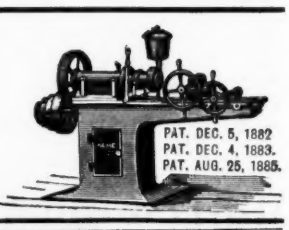
Single & Double Automatic Boltcutters,

cutting from 3-8 in. to 6 in. diameter,

Also SEPARATE HEADS AND DIES.

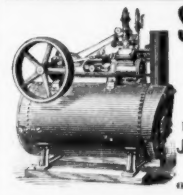
Send for Catalogue and Discounts.

Agents, Manning, Maxwell & Moore, New York.



THE HERCULES TRADE MARK PAT. JUNE 12, 1883

Section of **Copper-Wire-Sewed Light Double Belting,** specially adapted to use on cone pulleys and other hard places. Manufactured by the **PACE BELTING CO., Concord, N. H.** Also manufacturers of Staple and Special Grades of Leather Belting and the *"HERCULES"* Lacing. Send for Catalogue No. 2.



STEAM ENGINES

Upright and Horizontal, Stationary, Portable and Semi-Portable.

3 to 16 Horse Power.

Illustrated Pamphlet Free. Address

JAMES LEFFEL & CO

SPRINGFIELD, OHIO,

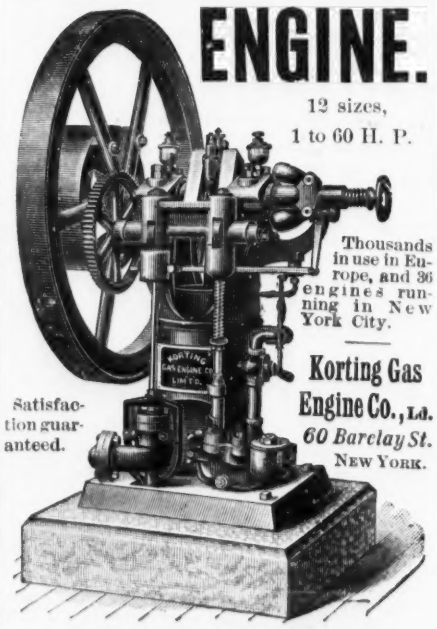
or 110 Liberty St., New York.

PATENTS

Obtained at moderate fees. Thorough work guaranteed. Good references. Send for pamphlet. Save time and expense by writing direct to R. G. DU BOIS, Patent Atty., 916 F St., Washington, D. C.

KORTING GAS ENGINE.

12 sizes, 1 to 60 H. P.



Thousands in use in Europe, and 36 engines running in New York City.

Satisfaction guaranteed.

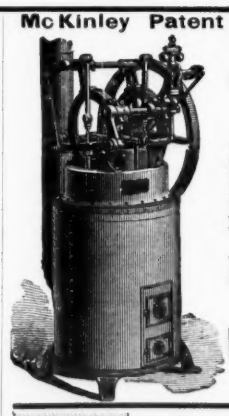
Korting Gas Engine Co., Ld.

60 Barclay St.

NEW YORK.

McKinley Patent

Air Engine.



The Best and Cheapest on the Market.

No Steam. No Water. Absolute Safety. No Engineer. No pumps. No Gauges. No liability to freeze up. No Regulation required.

NO EXTRA INSURANCE.

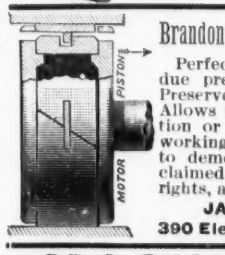
Can be used for any purpose where power is required.

Cheap Fuel. Cheap First Cost.

McKinley Engine Co.

17 Broadway,

CINCINNATI, O.



Brandon's Piston Ring Packing

Perfectly balanced against undue pressure in all directions. Preserves both cylinder and rings. Allows no waste by either friction or leakage. Call and see working model, expressly made to demonstrate advantages claimed. For packing or shop rights, address

JAMES BRANDON,

390 Eleventh Ave., New York.

MACHINERY.

BARGAIN LIST.

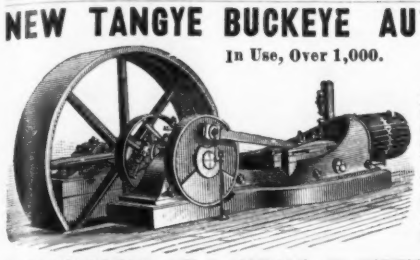
Two 16" swing, 6' bed, Engine Lathes (Porter), new.
" 17" " 8' " " " " (Wright), "
One Pond Planer, 22"x22"x5' second hand.
" Gray & Woods Dimension Planer, 22" wide, 14 long, second hand.
Two 65 H. P. Stationary Boilers, second hand,
One 60 " " " " "
" 50 " Portable " " "
" 35 " Center Crank Engine, new.
" 25 " " " " "
" 20 " " " " "
" 15 " " " " "
" 20 " Coil Boiler, suitable for a yacht.
" 12 " Vertical Engine, new.
" 30 " Portable " "
" Hand Planer, 18"x18"x24" second hand.

S. L. HOLT & CO.,

67 SUDBURY STREET, BOSTON, MASS.

NEW TANGYE BUCKEYE AUTOMATIC CUT-OFF ENGINES.

In Use, Over 1,000. 25 to 1,000 H. P.



These engines are the combined result of long experience with automatic cut-off regulation, and most careful revision of all details. They are designed and constructed for heavy and continuous duty at medium or high rotative speeds. Highest attainable Economy in Steam Consumption and superior regulation guaranteed. Self-contained Automatic Cut-off Engines 12 to 100 H.P. for driving Dynamo Machines *a specialty*. Illustrated Circulars, with various data as to practical Steam Engine construction and performance, free by mail. **Address, BUCKEYE ENGINE CO., Salem, Ohio.**

SALES AGENTS: W. L. SIMPSON, 301 TELEPHONE BUILDING, 18 CORTLANDT STREET, N. Y. {N. W. ROBINSON, cor. Clinton & Jackson Sts., Chicago, Ill. ROBINSON & CARY, St. Paul, Minn.

KENSINGTON ENGINE WORKS, LIMITED, PHILADELPHIA.

Sole Licensees and Manufacturers for New Jersey (South of Trenton), Eastern Pennsylvania, Delaware, Maryland and Virginia.

OTTO GAS ENGINE AGENCY, NEW YORK,

A. C. MANNING & CO.,

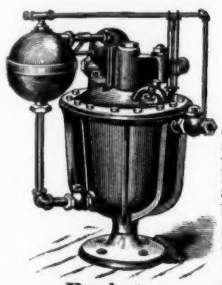
47 DEY STREET,

REMOVES on May 1st, to 18 VESEY ST.

THE ALBANY STEAM TRAP CO.'S

BUCKET AND GRAVITATING

TRAPS.

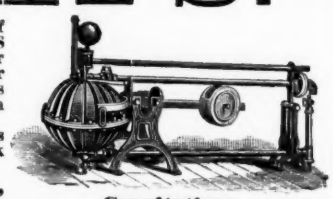


Bucket.

Automatically drain the water of condensation from **HEATING COILS** and return it to the boilers whether the coils are **above** or **below** the water level in boiler, doing away with pumps and other mechanical devices for such purposes.

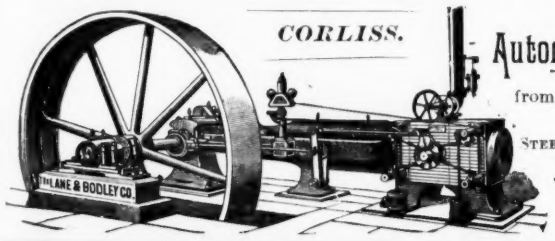
We also manufacture **Blessing's Patent Renewable Seat Stop and Check Valves.**—Send for Circular.

Albany Steam Trap Co. Albany, N. Y.



Gravitating.

The Lane & Bodley Co.



CORLISS.

MANUFACTURERS OF

Automatic Cut Off Engines,

from heavy patterns and of unexcelled workmanship.

STEEL BOILERS, FEED WATER HEATERS, SHAFTING, PULLEYS & GEARING.

THE LANE & BODLEY CO.

East side John, cor. Water,

Cincinnati, O.

PORTER-HAMILTON ENGINE.

FOR HEAVY WORK AND LARGE POWERS.

EXTRA HEAVY DESIGN.

Send for Catalogue.

WILLIAM TOD & CO.,

YOUNGSTOWN, OHIO.

THE SKINNER ENGINE CO.

ERIE, PA.

PORTABLE AND STATIONARY

ENGINES and BOILERS

Send for Catalogue and Prices.

REMOVED.

The Machine Tool Business of

E. P. BULLARD,

AND THE

Bridgeport Mach. Tool Works

Established at 14 DEY ST., in 1875,

has been REMOVED to the new and commodious stores,

72 WARREN ST., AND

62 COLLEGE PLACE,

Near Chambers St. Station of the Sixth Ave. Elevated R. R.

Send for New List of Tools for immediate delivery.

NEW YORK, April 6, 1887.

PATENT UNIVERSAL SCREW-CUTTING, CENTER, DEPTH ANGLE AND TWIST DRILL GAUGE.

J. WYKE & CO.

Fine Machinists' Tools, 2, BOSTON, MASS. Send for Circular.

VOLNEY W. MASON & CO.,

Friction Pulleys, Clutches and Elevators,

PROVIDENCE, R. I.

To Buyers of Engine Lathes

We are now making from entirely new designs, *extra heavy* 19" and 21" Engine Lathes (the most popular sizes), of which we are making a specialty, and manufacturing in lots of not less than 100 at a time.

We make no charge for extras. Every lathe is furnished with *hollow spindle*, the 19" with 1⅛" hole, and 21" with 1⅜" hole. Every lathe has substantial *compound rest*, heavy tool post (bar steel), rest to turn full swing, *following rest* with adjustable jaws to take any size from 2½" down, with extra tool for shafting.

Full set of gears to cut from 2 to 18 threads including 11½ pipe thread. *Automatic stop on carriage. Separate screw and rod feed,* and the most substantial and easily managed *taper attachment* made. Cones and gears of large diameter and wide belt. Studs, screws and small gears are *steel or gun metal*. Webbed live heads, heavy tail stocks. No worm or worm gears, no weak reverse plate. *Perfect lubrication for all running parts,* including carriage.

Lead screw inside of shear, double nut (cut from solid), and taking hold of carriage directly under the line of strain. Friction counter-shaft, the most durable made. Our prices are reasonable for cash, and from which no deviation will be made. Our written guarantee accompanies every lathe.

GUARANTEE.

We guarantee this lathe to be equal in workmanship, truth, accuracy, solidity, material and finish, to the best made, and hold ourselves legally liable for this guarantee.

LODGE, DAVIS & CO.

MANUFACTURERS

Machine Tools,

159, 161, 163 and 165 EGGLESTON AVE.,

136, 138, 146, 148, 150, 152, 154 E. 6th St.

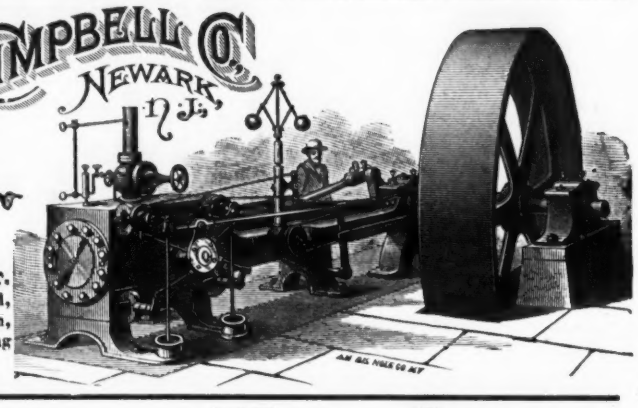
CINCINNATI, OHIO.

(See our advertisement on last page.)

The Watts, Campbell Co.

NEWARK, N. J.

MANUFACTURERS OF IMPROVED CORLISS STEAM ENGINES IN FULL VARIETY.



Sizes Varying From

30 to 2000 Horse Power.

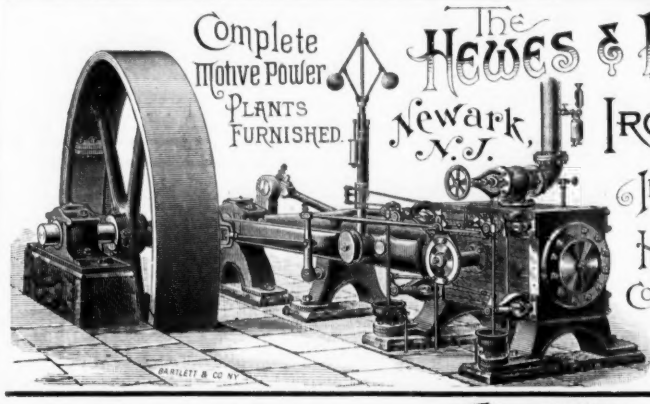
Horizontal or Vertical, Direct Acting or Beam, Condensing, Non-Condensing or Compound.

Send for Circular.

The Hewes & Phillips Iron Works

Newark, N. J.

Complete Motive Power Plants Furnished.



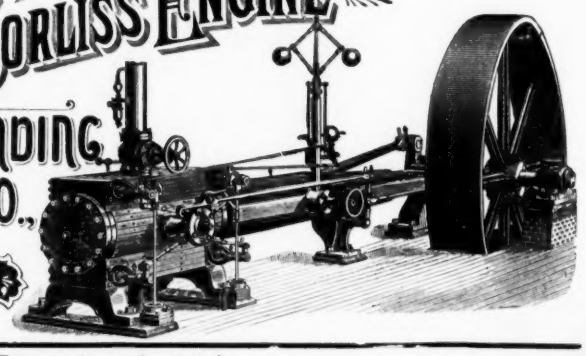
Improved CORLISS ENGINES, High Pressure. Condensing and Compound TUBULAR BOILERS.

GEO. A. BARNARD, AGENT.

THE IMPROVED FISHKILL CORLISS ENGINE

BUILT BY THE FISHKILL LANDING MACHINE CO.,

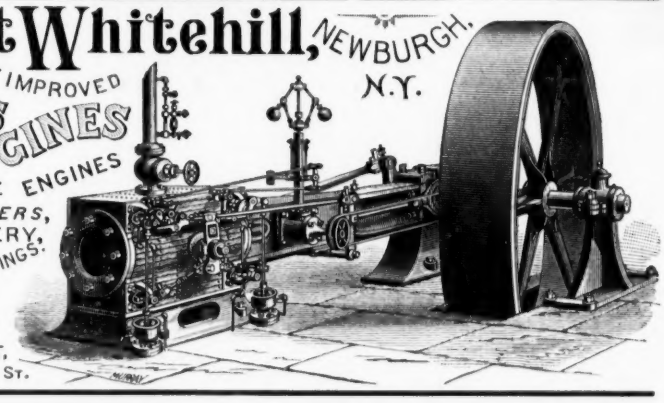
FISHKILL ON THE HUDSON, N. Y.



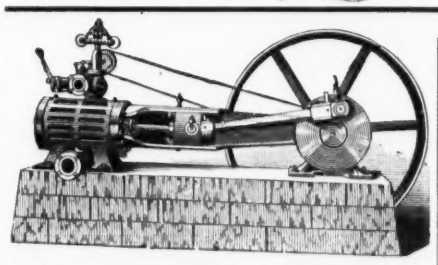
Robert Whitehill, NEWBURGH, N. Y.

MANUFACTURER OF IMPROVED CORLISS ENGINES

ALSO SLIDE VALVE ENGINES, STATIONARY BOILERS, GENERAL MACHINERY, IRON AND BRASS CASTINGS.



NEW YORK OFFICE Room 6, COAL AND IRON EXCHANGE, COR. CORTLANDT & CHURCH ST.



STEARNS MFG. COMPANY,

ERIE, PA.

Engines from 15 to 400 Horse Power.

Boilers of Steel and Iron supplied to the trade or the user. Send for Catalogues.

SAW MILLS and GENERAL MACHINERY.

Works at ERIE, PA.

EXTRA HEAVY LATHE

WE ARE MAKING A SPECIALTY OF A 24-INCH LATHE, WITH BED ANY LENGTH DESIRED. THIS LATHE IS DESIGNED FOR SEVERE SERVICE; IT IS THE HEAVIEST OF ITS SIZE EVER PRODUCED, AND THE WORKMANSHIP AS GOOD AS SKILL CAN MAKE IT.

SEND FOR CIRCULAR.

S. S. HEPWORTH & CO., "Glenwood Station," Yonkers, N. Y.

JOHN McLAREN,

HOBOKEN, N. J.

BUILDER OF

CORLISS ENGINES,

AIR COMPRESSORS AND BOILERS.

IRON PLANERS

FOR IMMEDIATE DELIVERY.

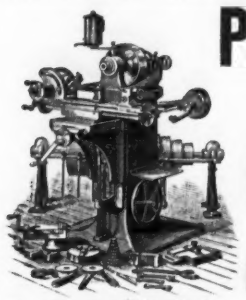
1	Whitcomb Planer,	22 in. x 22 in. x 5 ft.
2	Hendey "	22 in. x 22 in. x 5 ft.
1	Whitcomb "	24 in. x 24 in. x 6 ft.
1	Powell "	26 in. x 26 in. x 6 ft.
1	Flather "	26 in. x 26 in. x 6 ft.
1	" "	26 in x 26 in. x 8 ft.
1	Whitcomb "	27 in. x 27 in. x 7 ft.
1	" "	30 in. x 30 in. x 8 ft.
1	Gleason "	36 in. x 36 in. x 8 ft.

HILL, CLARKE & CO.

36 OLIVER STREET

BOSTON, MASS.

PRICES REDUCED.



No. 1 Universal Milling Machine.

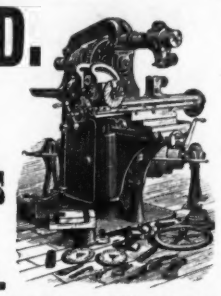
THE ORIGINAL

Universal Milling Machines

MADE BY THE

BROWN & SHARPE MFG. CO.

PROVIDENCE, R. I.,

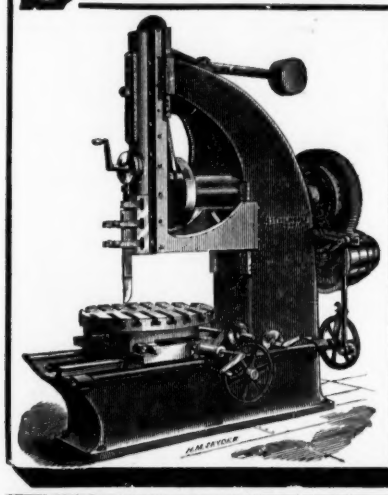


No. 3 Universal Milling Machine.

Are kept in stock and sold at favorable prices, compared with any of their **IMITATIONS.** *By making these Machines in large numbers, with expensive special tools, much greater accuracy has been attained than can be reached by the usual methods of manufacture. The importance of the greatest attainable accuracy in* **TOOL-MAKING MACHINES** *will be appreciated by Machinists.*

CORRESPONDENCE SOLICITED. CATALOGUE MAILED ON APPLICATION

SLOTTING MACHINES



9 to 48 in. Stroke. New Patterns.

RAM GUIDE

ADJUSTABLE VERTICALLY.

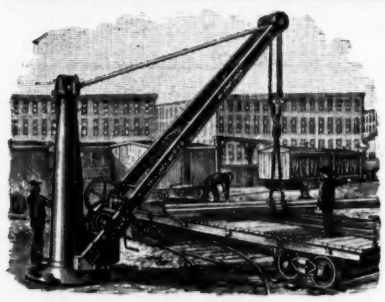
Feed always takes place at upper end of stroke—never during cut.

VERY HEAVY AND POWERFUL.

NILES TOOL WORKS

Hamilton, Ohio.

NEW YORK, - - 96 Liberty St.
PHILADELPHIA, - 705 Arch St.
CHICAGO, - - 96 Lake St.



PILLAR CRANE

PILLAR CRANES,

ANY CAPACITY.

Descriptive Circulars on application, and full Specification and Tender promptly submitted on receipt of capacity, height of hoist and effective radius desired. Standard sizes in stock.

SOLE MAKERS,

THE YALE & TOWNE MFG. CO.

STAMFORD, CONNECTICUT.

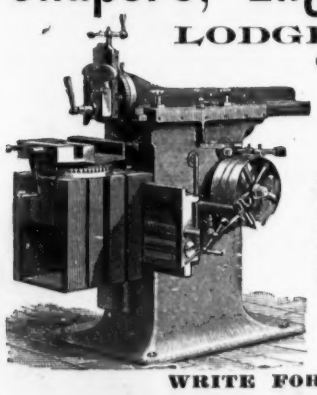
NEW YORK — CHICAGO — PHILADELPHIA — BOSTON.

Catalogues on application.

Shapers, Engine Lathes and Drills.

LODGE, DAVIS & CO.,

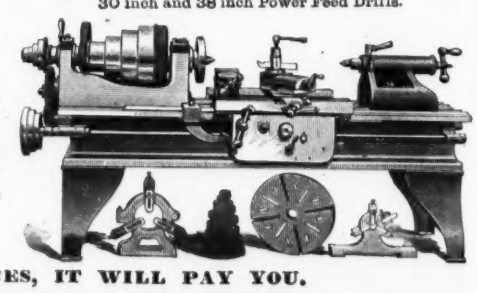
CINCINNATI, OHIO.



SHAPERS, 6", 8", 10", 20", 26", 32" Stroke.

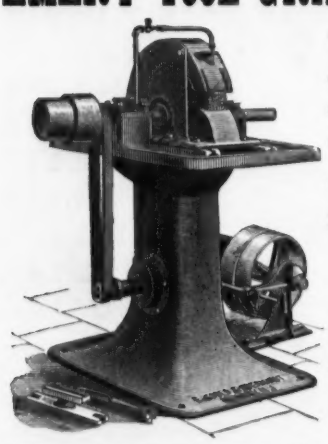
See page 15 Special Ad.

20 inch Upright Drills. | 26 inch Back Geared and
24 " " " | 30 inch and 38 inch Power Feed Drills.



WRITE FOR PRICES, IT WILL PAY YOU.

EBERHARDT'S EMERY TOOL GRINDER



Will not draw the Temper. Will ship on its Merits.

Write to

E. Gould & Eberhardt

97 to 111 N. J. R.R. Ave., Newark, N. J.

E. E. CARVIN & CO.,

MANUFACTURERS OF

Machinists and Iron Workers' Tools.

Universal Milling Machine.

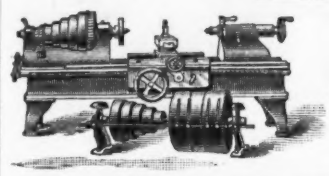
WE RECEIVED **GOLD MEDAL** FOR OUR NEW UNIVERSAL MILLER AT NEW ORLEANS EXHIBITION. (See cut.)

Lathes, Planers, Milling Machines and Drills. Special Tools for all kinds of manufacturing to order. Gear and Rack Cutting, Milling and Index Drilling to order.

Nos. 139 to 143 CENTRE ST., NEW YORK.

THE PRATT & WHITNEY CO.,

HARTFORD, CONN.,



Manufacture **LATHES** of Various Sizes

AND OF THE FOLLOWING KINDS:

Hand, Engine for Turning and Screw Cutting, Cutting Off, Gap Bed, Pulley Turning and Boring, Turret-Head Engine and Chucking, Hand Wheel, Rim Turning, Spinning, Grinding, Pattern Making, &c.

☞ PRICE LIST AND DISCOUNT SHEET SENT UPON APPLICATION.

The Billings & Spencer Co., Hartford, Ct.

MANUFACTURERS OF

DROP FORGINGS IN COPPER, IRON OR STEEL.

Pure Copper Commutator Bars for Electric Motors or Generators, Steel Commutator Rings and Nuts, Steel Wrenches and Eye Bolts.

DROP FORGINGS FROM PURE COPPER.
THE BILLINGS & SPENCER CO. HARTFORD, CONN.

WARNER & SWASEY, CLEVELAND, OHIO.

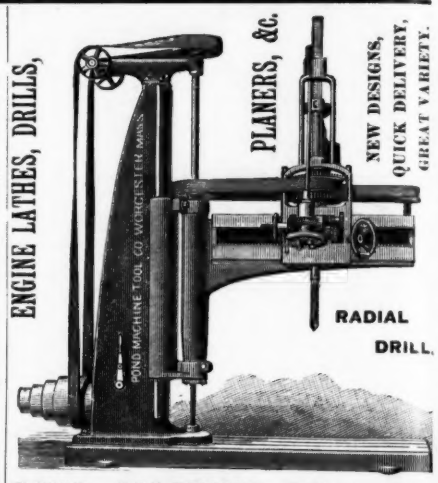
GLOBE VALVE CHUCK.

BRASS WORKING MACHINERY.

ILLUSTRATED CATALOGUE ON APPLICATION.

ENGINE LATHES, DRILLS, PLANERS, &c.

NEW DESIGNS, QUICK DELIVERY, GREAT VARIETY.



RADIAL DRILL.

POND MACHINE TOOL CO.

SUCCESSORS TO DAVID W. POND. Worcester, Mass.

GEO. W. FIFIELD,

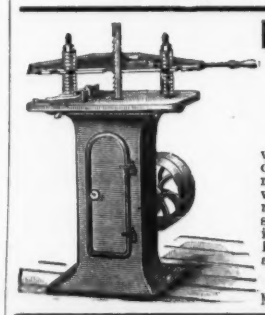
Manufacturer of ENGINE LATHES from 16 to 48 in. swing. Cuts, Photographs and Prices furnished on application. Lowell, Mass., U. S. A.

GEAR WHEELS & GEAR CUTTING

Send for Catalogue D.

GEORGE B. GRANT,

666 Beverly Street, Boston.



KEY-SEATING MACHINES,

and 20-in. Drills,

A SPECIALTY.

Our Key-Seating Machine will save enough in 60 days' use to pay first cost; no shop can afford to do without one. We have now ready for prompt shipment both Key-Seating Machines and 20-in. Drills. Send for Photo. and Catalogue.

W. P. DAVIS,

NORTH BLOOMFIELD, N. Y.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.

HARTFORD, CONN.

J. M. ALLEN, President.

W. B. FRANKLIN, Vice-President.

J. B. PIERCE, Secretary.

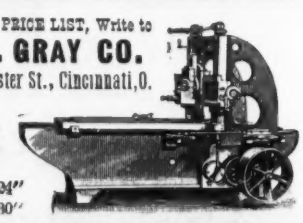
For New Reduced PRICE LIST, Write to

THE G. A. GRAY CO.

Sycamore & Webster St., Cincinnati, O.

Lathes, 17 in. 20 in.

Planers, 24"x24" 30"x30"



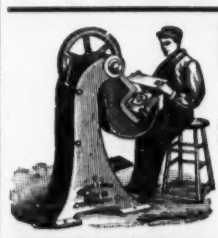
STEEL CASTINGS.

PRATT & LETCHWORTH,

PROPRIETORS

Buffalo Steel Foundry,

BUFFALO, N. Y.



PUNCHING PRESSES, DIES,

And other Tools for the Manufacture of all kinds of

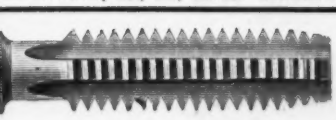
SHEET METAL GOODS, DROP FORGINGS, —ETC.— DROP HAMMERS.

STILES & PARKER PRESS CO.

MIDDLETOWN, CONN.

Branch Office and Factory 203, 205, and 207 CENTRE STREET, NEW YORK.

J.M. CARPENTER PAWTUCKET, R.I.



Manufacturer of TAPS & DIES